APPENDICES

Appendix A: East Reservoir Water Resources Management Requirements and Design Criteria

The following mitigation measures are intended to assist planning, contract preparation, and project contract administration by highlighting some of the most important requirements of Forest Service Handbook 2509.22, Soil and Water Conservation Practices, Montana Water Quality Best Management Practices (BMPs), and the Kootenai Forest Plan, including the Inland Native Fish Strategy. For additional detail, please review these guiding documents.

For modifications to these requirements, contact the hydrologist or fish biologist.

1. INFISH Buffers: Boundaries of RHCAs would be delineated prior to activities to exclude ground-based equipment and other activities. Incidental fire is allowed within the RHCAs, but no equipment or building of fire lines is allowed.
2. Best Management Practices (BMPs) for Forestry: BMPs for forestry would be met for all ground based operations. At a minimum, basic surface drainage requirements will be met for project roads with the intent of working towards meeting all required BMPs required under the Forest Service Handbook 2509.22, Soil and Water Conservation Practices, and Montana Water Quality Best Management Practices.
3. BMP Timing: Prior to timber haul, implement, and maintain all BMPs needed to control surface drainage on project roads. If winter haul will occur before planned road BMPs, the timber sale administrator will contact the appropriate engineer or hydrologist to assure that typical winter operation requirements are sufficient to mitigate sediment effects, or if specific BMPs will be necessary prior to winter operations.
4. Erosion Control Measures: Erosion control measures (i.e. straw bales, wattles, silt fences, hydro mulching, etc.) would be implemented where necessary and remain in place during and after ground disturbing activities. To ensure effectiveness, erosion control measures would remain functional until disturbed sites (roads, culverts, landings, etc.) are stabilized; typically for a minimum period of one growing season after ground disturbing activity occurs. Where necessary and as additionally described in the soils mitigation requirements, the timber sale administrator will determine and apply one or more of the following techniques to reduce the potential of soil detachment from disturbed areas such as skid trails, decommissioned roads, harvest units, sky-line corridors, or landings:

Facilitate rain and snow-melt infiltration by applying specified sub-soiling techniques to de-compact areas that are excessively compacted	Encourage ground cover by applying certified weed-free seed and/or mulch (mulch as approved wood fibers or straw)
Reduce rain drop energy, create shade, and facilitate wood deterioration for microbial soil functions by mechanically or hand applying appropriate quantities and sizes of wood slash.	Reduce concentration and magnitude of overland flow (should it occur) by installing water bars at appropriate spacing.

Appendix B: Standard RHCA Widths

Standard RHCA widths for four categories of stream or water body are:

(1) Fish bearing streams - minimum 300 feet each side of the stream;
(2) Perennial non fish bearing streams - minimum 150 feet each side of stream;
(3) Ponds, lakes, and wetlands greater than 1 acre - minimum 150 feet from maximum pool elevation;
(4) Intermittent and seasonally flowing streams, wetlands less than 1 acre, landslides and landslide prone areas - minimum 50 feet from edge except in priority watersheds (Streams identified by the USFWS as being of the highest importance for bull trout survival) where the minimum distance would be 100 feet.

Streams in the project area fall into categories 2 and 4 and should use appropriate buffering for management activities.

Appendix C: East Reservoir Best Management Practices (BMPs)

Federal agency compliance with pollution control is addressed through Section 313 of the Clean Water Act, Executive Order 12580 (January 23, 1987), National Nonpoint Source Policy (December 12, 1984), USDA Nonpoint Source Water Quality Policy (December 5, 1986) and the Environmental Protection Agency in their guidance "Nonpoint Source Controls and Water Quality Standards" (August 19, 1987). In order to comply with State and local non-point pollution controls the Forest Service will apply Best Management Practices (BMPs) to all possible non-point sources which may result from management activities proposed in this DEIS. These BMPs are the Soil and Water Conservation Practices described in the Forest Service Handbook (FSH) 2509.22.

BMPs are the primary mechanism for achievement of water quality standards (EPA, 1987). This appendix describes the Forest Service's BMP process in detail, and lists the key Soil and Water Conservation Practices that have been selected to be used in the action alternatives analyzed in this DEIS.

BMPs include, but are not limited to, structural, and non-structural controls, operations, and maintenance procedures. BMPs can be applied before, during, or after potential pollution-producing activities to reduce or eliminate the introduction of pollutants into the receiving watershed (40 CFR 130.2, EPA Water Quality Standards Regulation). BMPs are usually applied as a system of practices rather than a single practice. They are selected on the basis of site-specific conditions that reflect natural background conditions and political, social, economic, and technical feasibility.

The Forest Plan states that soil and water conservation practices, as outlined in the Soil and Water Conservation Practices Handbook (FSH 2509.22, May 1988), will be incorporated into all land use project plans as a principal mechanism for controlling non-point pollution sources, meeting soil and water quality goals, and protecting beneficial uses. Activities found not to comply with the soil and water conservation practices or State standards will be brought into compliance, modified, or stopped (USDA Forest Service, 1987a, pp. 11-23). Montana State Water Quality Standards require the use of reasonable land, soil, and water conservation practices (analogous to BMPs) as the controlling mechanism for non-point pollution. The use of BMPs is also required in the Memorandum of Understanding between the Forest Service and the State of Montana as part of the agency's responsibility as the designated water quality management agency on National Forest System lands.

BMP Implementation Process

In cooperation with the State, the Forest Service's primary strategy for the control of non-point sources of pollution is based on the implementation of preventive practices (i.e. BMPs). The BMPs have been designed and selected to protect the identified beneficial uses of the watershed.

The Forest Service non-point source management system consists of the following steps:

1) BMP Selection and Design - Water quality goals are identified in the Forest Plan. These goals meet or exceed applicable legal requirements including State water quality regulations, the Clean Water Act and the National Forest Management Act. Environmental assessments for projects are tiered to Forest Plans using the National Environmental Policy Act process. The appropriate BMPs are selected for each project by an interdisciplinary team. In each new location, there is flexibility to design different BMPs depending on local conditions and values and downstream beneficial uses of water. The BMP selection and design are dictated by the proposed activity, water quality objectives, soils, topography, geology, vegetation, and climate. Environmental impacts and water quality protection options are evaluated, and alternative mixes of practices are considered. A final collection of practices are selected that not only protect water quality but meet other resource needs. These final selected practices constitute the BMPs for the project.
2) BMP Application - The BMPs are translated into contract provisions, special use permit requirements, project plan specifications, and so forth. This insures that the operator or person responsible for applying the BMPs actually is required to do so. Site-specific BMP prescriptions are

taken from plan-to-ground by a combination of project layout and resource specialists (hydrology, fisheries, soils, etc.). This is when final adjustments to fit BMP prescriptions to the site are made.

3) BMP Monitoring - When the resource activity begins (e.g., timber harvest or road building), timber sale administrators, engineering representatives, resource specialists, and others insure the BMPs are implemented according to plan. BMP implementation monitoring is done before, during, and after resource activity implementation. This monitoring answers the question: Did we do what we said we were going to do? Once BMPs have been implemented, further monitoring is done to evaluate if the BMPs are effective in meeting management objectives and protecting beneficial uses. If monitoring indicates that water quality standards are not being met or beneficial uses are not being protected, corrective action will consider the following:
   a. Is the BMP technically sound? Is it really best or is there a better practice that is technically sound and feasible to implement?
   b. Was the BMP applied entirely as designated? Was it only partially implemented? Were personnel, equipment, funds, or training lacking which resulted in inadequate or incomplete implementation?
   c. Do the parameters and criteria that constitute water quality standards adequately reflect human-induced changes to water quality and beneficial uses?
4) Feedback - Feedback on the results of BMP evaluation is both short- and long-term in nature. Where corrective action is needed, immediate response will be undertaken. This action may include: modification of the BMP, modification of the activity, ceasing the activity, or possibly modification of the State water quality standard. Cumulative effects over the long-term may also lead to the need for possible corrective actions.

KNF BMP Selection and Design Form (KNF-BMP-1) (Revised 3/06)
Site-Specific Best Management Practices

Description of the soil and water conservation practices from the Forest Service Soil and Water Conservation Handbook (FSH 2509.22) will be applied in all alternatives. The location where the practices will be applied is specified in the table below. For a more detailed description of a specific BMP, refer to the Soil and Water Conservation Handbook.

Abbreviations used in this table:

SPS = Special Project Specification
TSC = Timber Sale Contract
TSA = Timber Sale Administrator
SMZ = Streamside Management Zone
IDT = Interdisciplinary Team
SWCP = Soil and Water Conservation Practice
KNF = Kootenai National Forest
PSF = Pre-sale Forester
ER = Engineering Representative
COR = Contracting Officer's Representative
SAM = Sale Area Map
FMO = Fire Management Officer

SWCP	SWCP OBJECTIVE	PERCENT EFFECTIVE	RECOMMENDED BEST MANAGEMENT PRACTICES BY IDT/TSA	CONSIDERATIONS FOR BEST MANAGEMENT PRACTICES	PERSON(S) RESPONSIBLE	CONTRACT PROVISIONS
14.01	TIMBER SALE PLANNING To incorporate soil and water resource considerations into Timber Sale Planning	94%	1. Unit design, mitigation, and effects analysis was done by IDT. 2. TSC will be prepared by PSF that will include management constraints and Design Criteria from EIS. 3. Use standard interim RHCA widths unless modified through watershed analysis. 4. Use exiting skid trails where feasible.	IDT has evaluated watershed characteristics and estimated response to proposed activities. EIS identifies design criteria to protect soil and water resources. Timber sale contracts will include provisions to meet water quality, soils, and other resources as directed by the Decision.	IDT; PSF	N/A
14.02	TIMBER HARVEST UNIT DESIGN - To insure that timber harvest unit design will secure favorable conditions of water flow, maintain water quality and soil productivity, and reduce soil erosion and sedimentation.	93%	1. Cumulative effects analysis and unit design were performed by IDT. 2. The prescriptions and unit design are consistent with direction outlined in the considerations for Best Management Practices. 3. Use standard interim RHCA widths unless modified through watershed analysis. 4. Use exiting skid trails where feasible.	Proposed activities were evaluated to estimate the potential watershed response. Prescriptions will be designed to assure an acceptable level of protection for soil and water resources. Management will protect soil/water values by avoiding sensitive areas, adjusting unit boundaries, adding specific BMPs to meet specific SWCPs, implementing the KNF Riparian Area Guidelines, applying mitigation, and applying implementation/ effectiveness monitoring.	IDT	N/A
14.03	USE OF SALE AREA MAPS (SAMs) FOR DESIGNATING SOIL AND WATER PROTECTION NEEDS - To delineate the location of protected areas and available water sources and insure their recognition, proper consideration, and protection on the ground.	91%	1. Water courses identified and protected using SMZ buffers as a minimum. 2. Skidding on dry, frozen, or snow-covered soil conditions. 3. Designated skid trails in units with previous harvest. 4. Use standard interim RHCA widths unless modified through watershed analysis.	The IDT will identify water courses to be protected, unit boundaries, and other features required by other means such as "C" provisions. Ground verification and preparation of SAMs to be included in TSC will be done by PSF. TSA reviews areas of concern with purchaser before operations.	IDT; PSF; TSA	B(T)1.1 B(T)6.5 C(T)6.50#

SWCP	SWCP OBJECTIVE	PERCENT EFFECTIVE	RECOMMENDED BEST MANAGEMENT PRACTICES BY IDT/TSA	CONSIDERATIONS FOR BEST MANAGEMENT PRACTICES	PERSON(S) RESPONSIBLE	CONTRACT PROVISIONS
14.04	LIMITING THE OPERATION PERIOD OF TIMBER SALE ACTIVITIES - To minimize soil erosion, sedimentation, and a loss in soil productivity by insuring that the purchaser conducts his/her operations in a timely manner.	98%	1. Units located on soils sensitive to compaction and/or displacement have been identified. 2. Designate units needing harvest on frozen or snow covered ground. 3. All other ground disturbing activities will occur during dry, frozen, or snow-covered conditions.	If limited operating periods are identified and recommended during the analysis by the IDT, the PSF will prepare a contract that includes provision C(T)6.316 and/or C(T)6.4#.	IDT; PSF; TSA	B(T)6.31 B(T)6.311 B(T)6.6 C(T)6.6 C(T)6.316# C(T)6.4#
14.05	PROTECTION OF UNSTABLE AREAS - To protect unstable areas and avoid triggering mass movements of the soil mantle and resultant erosion and sedimentation.	96%	1. Unstable landtypes will be identified during the planning process. 2. Units found to need further protection will use alternative yarding techniques, seasonal restrictions, and/or unit boundary adjustments.	If the NEPA analysis concluded that soils/geology in the area were unstable, BMPs would be designed to prevent irreversible soil and water damage.	IDT; PSF; TSA	C(T)6.4#
14.06	RIPARIAN AREA DESIGNATION - To minimize the adverse effects on riparian areas with prescriptions that manage nearby logging and related land disturbance activities.	88%	1. Identify areas with or adjacent to wet areas. 2. Default RHCA widths will be adhered to unless modified through watershed analysis. 3. SMZ widths will be used as a minimum if modification is proposed. 4. Areas found during sale layout will be reported to the Hydrologist and afforded the same protections as those identified during the planning process.	All streams and wetlands in the decision area will comply with KNF Riparian Area Guidelines (Appendix 26) and KNF Forest Plan as amended by INFS/UCRB. The width of the riparian areas will be decided upon by the IDT. These widths will be included on the sale area map and marked on the ground. This information will be included in the timber sale contract.	IDT; PSF; TSA	B(T)1.1 B(T)6.5, C(T)6.4# C(T)6.41# C(T)6.50#
14.07	DETERMINING TRACTOR-LOGGABLE GROUND - To protect water quality from degradation caused by tractor logging ground disturbance.	96%	1. Tractor loggable units (slopes < 40%) have been identified during the planning process. 2. Those areas found not to be tractor loggable were designated as cable, forwarder, or winter harvest units; or were dropped from the unit.	IDT has identified tractor-loggable ground (in conjunction with personnel from timber operations) during transportation and timber sale planning process. The results have been used to determine intensity of and restrictions for land disturbance activities. PSF will prepare a TSC that includes provisions stating areas and conditions under which tractors can operate.	IDT; PSF	C(T)6.4# SAM
14.08	TRACTOR SKIDDING DESIGN - To minimize erosion and sedimentation and protect soil productivity by designing skidding patterns to best fit the terrain.	97%	1. Identify units with designated or dispersed skid trails. 2. TSA and purchaser agree on proposed locations before operation.	IDT has identified sensitive areas during the planning process. The TSA will execute the plan on the ground by locating the skid trails with the timber purchaser or by agreeing to the purchaser's proposed locations prior to operation.	IDT; TSA	B(T)6.422 C(T)6.4#
14.09	SUSPENDED LOG YARDING IN TIMBER HARVESTING - To protect the soil from excessive disturbance and accelerated erosion and maintain the integrity of the riparian areas and other sensitive areas.	95%.	1. Units that have slopes that are unsuitable for or sensitive to ground base skidding will be identified. Units 26, 29, 116, 129, and portions of 19 and 38. 2. Units with sustained slopes >40% will be designated cable harvest units.	IDT recognizes the hazards associated with operating on steep and/or rocky slopes. Areas found to be of concern will use appropriate harvest systems that provide for a safe work environment and protect natural resources.	IDT	B(T)6.42 C(T)6.4# C(T)6.50#

SWCP	SWCP OBJECTIVE	PERCENT EFFECTIVE	RECOMMENDED BEST MANAGEMENT PRACTICES BY IDT/TSA	CONSIDERATIONS FOR BEST MANAGEMENT PRACTICES	PERSON(S) RESPONSIBLE	CONTRACT PROVISIONS
14.10	LOG LANDING LOCATION AND DESIGN - To locate in such a way as to avoid soil erosion and water quality degradation.	99%	1. TSA and purchaser agree on landing locations before operation. 2. Use least excavation needed. 3. No side-cast material into sensitive areas or waterways. 4. Install proper drainage.	TSA must agree to landing locations proposed by the purchaser. Approved landing locations will meet the criteria of: minimal size, least excavation needed, minimum skid roads necessary, no side-cast material into sensitive areas, and have proper drainage.	TSA	B(T)6.422 C(T)6.422
14.11	LOG LANDING EROSION PREVENTION AND CONTROL- To reduce erosion and subsequent sedimentation from log landing through the use of mitigating measures.	98%	1. Proper drainage will be installed and maintained during operation. 2. Landings will be scarified, seeded, and fertilized upon completion harvest activities. 3. TSA will assess conditions and take necessary steps to insure soil and water protection.	PSF and TSA assess what is necessary to prevent erosion from landing and to insure stabilization. It is up to the TSA to request technical assistance as needed.	PSF; TSA	C(T)6.6 BT6.64 B(T)6.6 C(T)6.633#
14.12	EROSION PREVENTION AND CONTROL MEASURES DURING THE TIMBER SALE OPERATION - To insure that the purchaser's operations shall be conducted reasonably to minimize soil erosion.	91%	1. Designate units with seasonal restrictions. 2. Do not operate during wet periods including spring-snowmelt and/or intense or long-duration rain storms. 3. TSA insures that erosion control is kept current and prevents operation when excessive impacts are possible.	PSF and TSA sets purchaser's responsibility to prevent soil/water resource damage in TSC. TSA insures that erosion control is kept current and prevents operation when excessive impacts are possible.	PSF; TSA	A13 B(T)6.6 B(T)6.64 C(T)6.6 C(T)6.601# C(T)6.633#
14.13	SPECIAL EROSION PREVENTION MEASURES ON AREAS DISTURBED BY HARVEST ACTIVITIES - To prevent erosion and sedimentation on disturbed areas.	91%	1. Waterbar, seed, fertilize, and place woody debris on skid trails, landings. 2. Recontour, seed, and place woody debris on constructed skid trails and temporary roads. 3. BMPs may be adjusted by the TSA to meet operational requirements	IDT identifies locations needing special stabilization measures. If any such areas are identified, BMPs may be adjusted by the TSA to meet operational requirements	IDT	C(T)6.601# C(T)6.32# C(T)6.633#
14.14	REVEGETATION OF AREAS DISTURBED BY HARVEST ACTIVITIES - To establish a vegetative cover on disturbed areas to prevent erosion and sedimentation.	94%	1. Seed and fertilize areas of exposed soil with KNF approved vegetative and fertilizer mix.	IDT has established vegetation and fertilizer mix to be used in the project area with outlines on the extent to which it should be used. TSA is responsible for seeing that revegetation work required by purchaser is done correctly and in a timely manner. The purchaser will be responsible for revegetation immediately after the completion of harvest. Funds will be collected for the District to do follow-up seeding/fertilizing in years two and three after harvest.	IDT; TSA	C(T)6.01# C(T)6.633#
14.15	EROSION CONTROL ON SKID TRAILS - To protect water quality by minimizing erosion and sedimentation derived from skid trails.	87%	1. Insure proper skid trail location. 2. Insure proper drainage on skid trails. 3. Recontour, seed, and place woody debris on constructed skid trails and temporary roads. 4. Insure maintenance of erosion control structures by purchaser.	Erosion control measures may be recommended by the IDT, but site-specifically adjusted by the TSA. TSA will insure erosion control measures are applied prior to expected hydrologic events (spring runoff, high-intensity storms, etc.). Maintenance of erosion control structures by the purchaser may be necessary and requested by the TSA.	TSA	C(T)6.6 C(T)6.633# B(T)6.6 B(T)6.65 B(T)6.66

SWCP	SWCP OBJECTIVE	PERCENT EFFECTIVE	RECOMMENDED BEST MANAGEMENT PRACTICES BY IDT/TSA	CONSIDERATIONS FOR BEST MANAGEMENT PRACTICES	PERSON(S) RESPONSIBLE	CONTRACT PROVISIONS
14.16	WET MEADOW PROTECTION DURING TIMBER HARVESTING - To avoid damage to the ground cover, soil, and water in meadows.	84%	1. Identify units with or adjacent to wet meadows. Units 9, 10, 12, 17, 23, 52, 120, and 212 have wet meadows, wetlands, and/or ponds in or adjacent to their boundaries. 2. Units with unmapped wet areas will be reported to Hydrologist and afforded the same protection as those identified during the planning process. 3. Standard interim RHCA widths will be adhered to unless modification is in place. 4. The SMZ law will be met or exceeded.	IDT has identified areas needing special protection. PSF will verify the areas needing protection and prepare the contract to prevent damage to meadows. The TSA will be responsible for on-the-ground protection of meadows. If meadows are found by the TSA during operations, it is their responsibility to either afford them the proper protection or pursue a contract modification.	IDT; PSF; TSA	B(T)1.1 B(T)5.1 B(T)6.422 B(T)6.61 C(T)6.4# C(T)6.62#
14.17	STREAM CHANNEL PROTECTION (IMPLEMENTATION AND ENFORCEMENT) - Protect natural stream flows; provide unobstructed passage of flows; reduce sediment input; and restore flow if diverted by timber sale activity.	91%	1. Standard interim RHCA widths will be adhered to unless modification is in place. 2. SMZ widths will be used at a minimum if modification in place. 3. SMZ law will be met or exceeded.	IDT has identified the location of channels in the decision area. PSF will prepare a SAM locating the channels needing protection. Layout crew marks boundaries and trees according to HB-731 and FP guidelines. TSA will see that TSC items are carried out on the ground. Technical assistance will be consulted as needed.	IDT; PSF; TSA	B(T)1.1 B(T)6.5 B(T)6.6 C(T)6.50# C(T)6.6
14.18	EROSION CONTROL STRUCTURE MAINTENANCE - To insure that constructed erosion control structures are stabilized and working effectively.	93%	1. During the period of the TSC, the purchaser is responsible for maintaining their erosion control features.	During the period of the TSC, the purchaser is responsible for maintaining their erosion control features. If work is needed beyond this time, the District will pursue other sources of funding.	IDT; PSF; TSA	B(T)6.66 B(T)6.67
14.19	ACCEPTANCE OF TIMBER SALE EROSION CONTROL MEASURES BEFORE SALE CLOSURE - To assure the adequacy of required erosion control work on timber sales.	97%	1. TSA reviews erosion prevention work before each harvest unit is considered complete. 2. The inspection will determine if the work is acceptable and will meet the objective of the erosion control feature.	A careful review of erosion prevention work will be made by the TSA before each harvest unit is considered complete. The inspection will determine if the work is acceptable and will meet the objective of the erosion control feature. A feature is considered not acceptable if it does not meet standards or is not expected to protect soil/water values. Technical assistance will be used as necessary.	TSA	B(T)6.36
14.20	SLASH TREATMENT IN SENSITIVE AREAS - To protect water quality by protecting sensitive tributary areas from degradation that would result from using mechanized equipment for slash disposal.	92%	1. Where harvest is proposed within riparian areas, either slash should be removed with the tree or scattered and not treated. 2. Mechanical fuels treatments should occur on slopes < 40%.	All activities will comply with the KNF Riparian Area Guidelines (FP, Appendix 26). Where harvest within riparian areas is proposed, either the slash would be removed with the tree or scattered and not treated.	TSA; FMO	B(T)6.5 C(T)6.50# B(T)6.7 C(T)6.7 C(T)6.71 C(T)6.753

SWCP	SWCP OBJECTIVE	PERCENT EFFECTIVE	RECOMMENDED BEST MANAGEMENT PRACTICES BY IDT/TSA	CONSIDERATIONS FOR BEST MANAGEMENT PRACTICES	PERSON(S) RESPONSIBLE	CONTRACT PROVISIONS
14.22	MODIFICATION OF THE TSC - To modify the TSC if new circumstances or conditions indicate the timber sale will cause irreversible damage to soil, water, or watershed values.	100%	1. Environmental modification procedure.	If TSC is not adequate to protect soil/water resources, the TSA and Contracting Officer are responsible for recommending modification of the TSC.	TSA	B(T)8.33
15.01	GENERAL GUIDELINES FOR TRANSPORTATION PLANNING - To introduce soil and water resource considerations into transportation planning.	100%	1. Complete a roads analysis. 2. Transportation plans include installation and maintaining proper drainage.	A roads Analysis has been completed. The IDT has evaluated watershed characteristics and estimated the response of soil and water resources to proposed transportation alternatives and activities.	IDT; ER	N/A
15.02	GENERAL GUIDELINES FOR THE LOCATION AND DESIGN OF ROADS AND TRAILS - To locate and design roads and trails with minimal soil and water impact while considering all design criteria.	96%	1. Follow INFS Standards and Guidelines for road management. 2. Identify sensitive landtypes, riparian areas, and wetlands during planning. 3. Use the minimum amount of roads and trails necessary.	The IDT has insured that the location and design of roads and trails are based on multiple resource objectives. Mitigation measures have been designed to protect the soil and water resources identified in the NEPA process. Contract provisions will be prepared by the ER that meets the soil and water resource protection requirements.	IDT; ER	N/A
15.03	ROAD AND TRAIL EROSION CONTROL PLAN - To prevent, limit, and mitigate erosion, sedimentation, and resulting water quality degradation prior to the initiation of construction by timely implementation of erosion control practices.	95%	1. Seed and fertilize disturbed areas. 2. Install proper ditching and road slope. 3. Install proper drainage. 4. Incorporate road grade breaks. 5. Use minimum road or trail length/width necessary. 6. Avoid wet areas or areas of sensitive soil types.	IDT has established soil/water conservation objectives and mitigation measures. ER will then prepare a contract that reflects the objectives. ER will see that erosion control measures are approved and completed in a timely manner. IDT reviews projects to check effectiveness of erosion control features.	IDT; ER	B(T)6.31 B(T)6.6 B(T)6.312
15.04	TIMING OF CONSTRUCTION ACTIVITIES - To minimize erosion by conducting operations during minimal runoff periods.	97%	1. Avoid construction during wet periods.	IDT has outlined detailed erosion control measures in NEPA process. ER puts these measures into contract provisions. Compliance is assured by Contracting Officer or ER.	IDT; ER	B(T)6.31 B(T)6.312 B(T)6.6 SPS 204
15.05	SLOPE STABILIZATION AND PREVENTION OF MASS FAILURES - To reduce sedimentation by minimizing the chances for road-related mass failures, including landslides and embankment slumps.	99%	1. Avoid construction across unstable areas. 2. Construct embankments following approved engineering practices. 3. Use minimum road or trail length/width necessary.	Road and trail construction in mountainous terrain requires cutting and loading natural slopes which may lead to landslides and/or embankment failures. In areas with intrinsic slope stability problems, appropriate technical resource personnel must be involved in an interdisciplinary approach to route location.	IDT; ER	N/A

SWCP	SWCP OBJECTIVE	PERCENT EFFECTIVE	RECOMMENDED BEST MANAGEMENT PRACTICES BY IDT/TSA	CONSIDERATIONS FOR BEST MANAGEMENT PRACTICES	PERSON(S) RESPONSIBLE	CONTRACT PROVISIONS
15.06	MITIGATION OF SURFACE EROSION AND STABILIZATION OF SLOPES - To minimize soil erosion from road cutslopes, fill slopes, and travel ways.	94%	1. Seed and fertilize cut and fill slopes. 2. Install proper ditching and road slope. 3. Install proper drainage. 4. Incorporate road grade breaks. 5. Install ditch relief culverts before/after stream crossings.	IDT has outlined detailed erosion control measures in the NEPA process. Stabilization techniques are included in contract provisions. Compliance is assured by Contracting Officer or ER.	IDT; ER	SPS 203, 204, 206A 210, 412 619, 625, 626 630 B(T)5.3, B(T)6.31 B(T)6.6, B(T)6.62 B(T)6.66 B(T)6.312, C(T)6.6 C(T)6.601#
15.07	CONTROL OF PERMANENT ROAD DRAINAGE - To minimize the erosive effects of concentrated water and degradation of water quality by proper design and construction of road drainage systems and drainage control structures.	94%	1. Avoid long, steep grades. 2. Maintain adequate surface drainage. 3. Prevent erosion of culvert fills. 4. Maintain ditches. 5. Ditch relief culverts before/after stream crossings.	IDT has identified locations, design criteria, drainage control features, and mitigation. Compliance will be assured by the ER/Contracting Officer.	ER	B(T)5.3 C(T)5.31# B(T)6.311 B(T)6.6 C(T)6.6
15.08	PIONEER ROAD CONSTRUCTION - To minimize sediment production and mass wasting associated with pioneer road construction.	100%	1. Insure stable slopes during construction. 2. Seed and fertilize exposed soil. 3. Avoid construction during wet periods. 4. Use slash filter windrows.	ER/Contracting Officer will be responsible for enforcing contract specifications. The purchaser is responsible for submitting an operating plan that includes erosion control measures.	ER	B(T)6.6 B(T)5.23 B(T)6.31 B(T)6.312 B(T)6.311 SPS 204
15.09	TIMELY EROSION CONTROL MEASURES ON INCOMPLETE ROADS AND STREAM CROSSING PROJECTS - To minimize erosion of and sedimentation from disturbed ground on incomplete projects.	96%	1. Avoid construction during wet periods. 2. Use slash filter windrows or silt fence. 3. Seed and fertilize disturbed areas.	IDT has identified project location and mitigation measures in NEPA process. Protective measures will be kept current on all areas of disturbed, erosion-prone areas. TSA insures contract compliance.	IDT; TSA	B(T)6.31 B(T)6.6 B(T)5.23 B(T)6.66 C(T)6.6
15.10	CONTROL OF ROAD CONSTRUCTION, EXCAVATION, AND SIDE-CAST MATERIAL - To reduce sedimentation from unconsolidated excavated and side-cast material caused by road construction, reconstruction, or maintenance.	96%	1. Do not side-cast into waterways or sensitive areas. 2. Use slash filter windrows or silt fence.	IDT has identified project location and mitigation measures in NEPA process. Protective measures will be kept current on all areas of disturbed, erosion-prone areas. TSA insures contract compliance.	IDT; TSA	B(T)5.3 C(T)5.31# SPS 203 SPS 204

SWCP	SWCP OBJECTIVE	PERCENT EFFECTIVE	RECOMMENDED BEST MANAGEMENT PRACTICES BY IDT/TSA	CONSIDERATIONS FOR BEST MANAGEMENT PRACTICES	PERSON(S) RESPONSIBLE	CONTRACT PROVISIONS
15.11	SERVICING AND REFUELING EQUIPMENT - To prevent contamination of waters from accidental spills of fuels, lubricants, bitumens, and other harmful materials.	99%	1. Insure proper fuel storage and transportation. 2. Keep fuel from streams, wetlands, ponds, and lakes.	ER/TSA/Contracting Officer will designate the location, size, and uses of service refueling areas. All projects will adhere to the KNF Hazardous Substance Spill Plan in case of accidents.	ER; TSA	B(T)6.222 B(T)6.34 B(T)6.341
15.12	CONTROL OF CONSTRUCTION IN RIPARIAN AREAS - To minimize the adverse effects on riparian areas from roads.	97%	1. Follow INFS Standards and Guidelines for construction within riparian areas. 2. Use slash filter windrows or silt fence. 3. Install ditch relief culverts and surface water deflectors before/after stream crossings.	Proposed new and temporary roads will adhere to guidelines in the Montana Streamside Management Zone Law (HB-731). All road activities will follow INFS Standards and Guidelines for road management.	ER; TSA	B(T)6.5 B(T)6.62 C(T)6.50# SPS 206 SPS 206A
15.13	CONTROLLING IN-CHANNEL EXCAVATION - To minimize stream channel disturbances and related sediment production.	94%	1. Use silt fence to minimize introduced sediment. 2. Use minimum amount of road. 3. Construct minimum number of crossings.	BMP improvements at crossings would adhere to the guidelines in Montana Streamside Management Zone Law (HB-731) and the INFS Standards and Guidelines for road management.	ER; TSA	B(T)6.5 SPS 204 SPS 206 206A
15.14	DIVERSION OF FLOWS AROUND CONSTRUCTION SITES: To minimize downstream sedimentation by insuring all stream diversions are carefully planned.	93%	1. Divert streamflow around construction. 2. Use silt fence to minimize introduced sediment. 3. Construction during low-flow	The IDT has determined, where stream crossings meet multiple resource objectives, the crossings would require a State 124 permit. This would require the State Fish, Wildlife, and Parks to review the adequacy of the proposed mitigation. Compliance with contract provisions would be done by the ER.	IDT; ER	B(T)6.5 B(T)6.31 C(T)6.50# C(T)6.6
15.15	STREAM CROSSINGS ON TEMPORARY ROADS: To keep temporary roads from unduly damaging streams, disturbing channels, or obstructing fish passage.	96%	1. Consult Hydrologist on placement of crossing 2. Use minimum number of stream crossings. 3. Construction during low-flow. 4. Follow INFS Standards and Guidelines for construction within riparian areas.	The IDT identifies areas in need of a temporary road during the NEPA process. Proposed stream crossings would adhere to the guidelines in Montana Streamside Management Zone Law (HB-731).	PSF	N/A
15.16	BRIDGE AND CULVERT INSTALLATION: To minimize sedimentation and turbidity resulting from excavation for in-channel structures.	98%	1. Installation should be done during periods of low flow. 2. Instream sediment retention devices should be used throughout implementation.	IDT has identified project location and mitigation measures in NEPA process. Protective measures will be kept current on all areas of disturbed, erosion-prone areas. TSA insures contract compliance.	IDT; TSA	C(T)6.5#
15.17	REGULATION OF BORROW PITS, GRAVEL SOURCES, AND QUARRIES: To minimize sediment production from borrow pits, gravel sources, and quarries and limit channel disturbance in those gravel sources suitable for development in floodplains.	98%			ER	B(T)6.5 C(T)6.50#

SWCP	SWCP OBJECTIVE	PERCENT EFFECTIVE	RECOMMENDED BEST MANAGEMENT PRACTICES BY IDT/TSA	CONSIDERATIONS FOR BEST MANAGEMENT PRACTICES	PERSON(S) RESPONSIBLE	CONTRACT PROVISIONS
15.18	DISPOSAL OF RIGHT-OF-WAY AND ROADSIDE DEBRIS: To insure that debris generated during road construction is kept out of streams and prevent slash and debris from subsequently obstructing channels.	97%	1. Debris and slash generated during road construction should not be side-cast into streams.	Proposed road construction will adhere to the guidelines in the Montana Streamside Management Zone Law (HB-731).	ER	Std Spec 201 SPS 201
15.19	STREAM BANK PROTECTION: To minimize sediment production from stream banks and structural abutments in natural waterways.	98%	1. Take precautions to minimize or eliminate disturbance to stream banks. 2. Maintain instream structures.	IDT has identified project location and mitigation measures during NEPA process. Protective measures will be kept current on all areas of disturbed soils. TSA and ER insures contract compliance.	IDT; ER; TSA	Std Spec 619
15.20	WATER SOURCE DEVELOPMENT CONSISTENT WITH WATER QUALITY PROTECTION: To supply water for road construction and maintenance and fire protection while maintaining water quality.	91%			ER; FMO	Std Spec 207
15.21	MAINTENANCE OF ROADS: To maintain all roads in a manner that provides for soil and water protection by minimizing rutting, failures, side-cast, and blockage of drainage facilities.	96%	1. Contract Clause CT 5.31#.	Road maintenance associated with a timber sale is the responsibility of purchaser. The ER/SA will insure that the purchaser maintains roads according to the appropriate maintenance level.	ER; SA	B(T)5.12 B(T)5.3 B(T)6.6 C(T)6.6 C(T)5.32# B(T)6.31
15.22	ROAD SURFACE TREATMENT TO PREVENT LOSS OF MATERIALS: To minimize the erosion of road surface materials and, consequently, reduce the likelihood of sediment production.	97%	1. Maintenance of road surface should include proper blading and/or dust abatement. 2. Use crush-gravel where necessary.	Protective measures will be kept current on all areas of disturbed, erosion-prone areas. ER insures contract compliance.	IDT; ER	B(T)5.3 C(T)5.31# C(T)5.314#
15.23	TRAFFIC CONTROL DURING WET PERIODS: To reduce the potential for road surface disturbance during wet weather and reduce sedimentation.	96%	1. Avoid hauling during wet periods.	Road restrictions and traffic control measures will be implemented on all haul roads when damage would occur during spring breakup. The decision to restrict a road is made by the ER. Hauling restrictions would be controlled by the TSA.	ER; TSA	B(T)6.6 C(T)6.6 C(T5).316# C(T)5.41#

SWCP	SWCP OBJECTIVE	PERCENT EFFECTIVE	RECOMMENDED BEST MANAGEMENT PRACTICES BY IDT/TSA	CONSIDERATIONS FOR BEST MANAGEMENT PRACTICES	PERSON(S) RESPONSIBLE	CONTRACT PROVISIONS
15.24	SNOW REMOVAL CONTROLS: To minimize the impact of snow melt on road surfaces and embankments and reduce the probability of sediment production resulting from snow removal operations.	96%	1. Be careful not to leave snow berm at edge of road where possible. 2. Where a berm cannot be avoided, insure proper drainage by opening sections of berm to allow water to leave road surface.	Snow removal will be kept current on all roads associated with winter logging operations. The TSA insures compliance with contract provisions.	IDT; TSA	C(T)5.316# Std Spec 203.09
15.25	OBLITERATION OF TEMPORARY ROADS: To reduce sediment generated from temporary roads by obliterating them at the completion of their intended use.	95%	1. Re-contour road fully where feasible. 2. Seed and fertilize exposed soil. 3. Pull slash and woody debris back onto rehabilitated road.	This work will be done on all new temporary roads in the decision area. The work will be done by the purchaser with compliance by the TSA.	TSA	B(T)6.63 C(T)6.6 C(T)6.632# C(T)6.633#
18.03	PROTECTION OF SOIL AND WATER FROM PRESCRIBED BURNING EFFECTS: To maintain soil productivity, minimize erosion, and prevent ash, sediment, nutrients, and debris from entering surface water.	100%	1. Follow INFS Standards and Guidelines for burning in RHCAs. 2. Adhere to SMZ Law. 3. Where harvest within riparian areas is proposed, either the slash should be removed with the tree or scattered and not treated.	Broadcast burning adjacent to riparian areas will adhere to guidelines in the Montana Streamside Management Zone Law (HB-731). Prescribed burn plans identify the conditions necessary to prevent soil damage and meet site preparation objectives.	FMO	N/A

Appendix D: **Kootenai National Forest BMP Monitoring Summary**

KOOTENAI NATIONAL FOREST BMP TRACKING-DOCUMENTATION																
SUMMARY: 1991 - 2011																
	IMPLEMENTATION SCORES								EFFECTIVENESS SCORES							
SWCP/BMP PRACTICE #	1	2	3	4	5	Total	% 4 or 5	% 3 or less	1	2	3	4	5	Total	% 4 or 5	% 3 or less
11.1	0	0	1	12	0	13	92	8	0	0	0	2	0	2	100	0
11.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.3	0	3	2	58	1	64	92	8	0	1	1	52	0	54	96	4
11.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.5	0	0	0	2	0	2	100	0	0	0	0	0	0	0	0	0
11.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.7	1	2	1	279	7	290	99	1	0	1	3	127	0	131	97	3
11.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.9	0	0	0	223	4	227	100	0	0	0	0	77	0	77	100	0
11.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.11	0	0	1	0	0	1	0	100	0	0	0	0	0	0	0	0
11.12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.13	0	0	0	37	1	38	100	0	0	0	1	7	0	8	88	13
12.1	0	0	1	1	0	2	50	50	0	0	1	1	0	2	50	50
12.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.7	0	0	0	1	0	1	100	0	0	0	0	1	0	1	100	0
12.8	0	0	0	1	0	1	100	0	0	0	0	1	0	1	100	0
12.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.10	0	0	0	1	0	1	100	0	0	0	0	0	0	0	0	0
12.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.1	0	0	1	79	3	83	99	1	0	0	2	66	1	69	97	3
13.2	0	12	69	1416	6	1503	95	5	0	4	33	790	1	828	96	4
13.3	1	10	45	533	7	596	91	9	1	4	33	241	2	281	86	14
13.4	0	0	10	341	8	359	97	3	0	0	15	278	3	296	95	5
13.5	0	4	16	246	0	266	92	8	0	1	12	229	0	242	95	5
13.6	0	6	37	581	5	629	93	7	1	4	24	243	1	273	89	11
13.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

13.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.20	0	0	1	107	0	108	99	1	0	0	1	107	0	108	99	1
14.1	0	0	0	42	0	42	100	0	0	0	1	15	0	16	94	6
14.2	3	5	49	1362	11	1430	96	4	0	3	32	636	5	676	95	5
14.3	0	2	33	795	4	834	96	4	1	1	22	311	2	337	93	7
14.4	0	0	9	1131	1	1141	99	1	0	2	6	623	0	631	99	1
14.5	1	1	8	307	5	322	97	3	1	1	6	203	0	211	96	4
14.6	0	3	32	587	10	632	94	6	3	3	22	251	3	282	90	10
14.7	1	7	29	926	9	972	96	4	0	2	13	476	2	493	97	3
14.8	0	4	39	1395	22	1460	97	3	0	2	20	840	5	867	97	3
14.9	0	3	15	374	4	396	95	5	0	2	7	166	3	178	95	5
14.10	0	0	16	1660	13	1689	99	1	0	0	10	939	2	951	99	1
14.11	0	0	20	1616	13	1649	99	1	0	0	15	850	2	867	98	2
14.12	3	6	42	1271	11	1333	96	4	0	7	43	531	2	583	91	9
14.13	3	5	44	697	2	751	93	7	1	5	29	447	1	483	93	7
14.14	0	2	18	994	3	1017	98	2	0	3	23	526	2	554	95	5
14.15	3	8	60	1581	19	1671	96	4	5	12	80	800	2	899	89	11
14.16	0	7	32	279	1	319	88	12	1	4	22	179	1	207	87	13
14.17	0	5	24	780	12	821	96	4	4	5	19	331	12	371	92	8
14.18	0	6	12	918	1	937	98	2	2	7	24	401	0	434	92	8
14.19	0	1	19	1035	5	1060	98	2	0	1	10	354	2	367	97	3
14.20	0	2	17	446	7	472	96	4	1	12	9	303	1	326	93	7
14.21	0	0	0	54	2	56	100	0	0	0	0	3	1	4	100	0
14.22	0	0	1	98	8	107	99	1	0	0	0	31	2	33	100	0
14.23	0	0	0	9	0	9	100	0	0	0	0	1	0	1	100	0
15.1	0	0	0	36	0	36	100	0	0	0	0	26	0	26	100	0
15.2	0	7	42	1097	8	1154	96	4	0	9	38	890	3	940	95	5
15.3	0	2	4	218	13	237	97	3	0	0	8	164	8	180	96	4
15.4	0	0	6	156	6	168	96	4	0	0	3	111	6	120	98	3
15.5	0	0	3	227	2	232	99	1	0	0	1	181	2	184	99	1
15.6	0	2	14	412	8	436	96	4	1	2	14	301	3	321	95	5
15.7	0	2	52	627	14	695	92	8	0	5	28	533	26	592	94	6
15.8	0	0	12	60	3	75	84	16	0	0	0	39	2	41	100	0
15.9	0	1	15	211	7	234	93	7	0	2	4	130	6	142	96	4

15.10	0	2	3	213	6	224	98	2	0	0	8	167	3	178	96	4
15.11	1	3	4	913	5	926	99	1	0	1	5	555	0	561	99	1
15.12	0	2	1	143	4	150	98	2	0	2	1	123	4	130	98	2
15.13	0	0	6	193	6	205	97	3	0	1	6	152	7	166	96	4
15.14	0	1	1	43	4	49	96	4	0	0	2	25	3	30	93	7
15.15	0	1	6	232	0	239	97	3	0	1	5	183	0	189	97	3
15.16	0	0	13	127	8	148	91	9	0	2	1	106	8	117	97	3
15.17	0	0	1	111	2	114	99	1	0	1	1	100	3	105	98	2
15.18	0	1	1	145	6	153	99	1	0	0	2	86	3	91	98	2
15.19	0	1	1	90	3	95	98	2	0	1	0	51	5	57	98	2
15.20	0	2	4	127	0	133	95	5	1	1	5	100	0	107	93	7
15.21	0	3	43	2129	10	2185	98	2	0	10	30	981	3	1024	96	4
15.22	0	1	13	703	14	731	98	2	0	1	7	304	9	321	98	2
15.23	0	4	26	1363	3	1396	98	2	0	2	17	586	0	605	97	3
15.24	0	2	8	743	2	755	99	1	0	1	8	266	0	275	97	3
15.25	0	2	9	624	22	657	98	2	0	2	10	335	4	351	97	3
15.26	0	0	1	1	0	2	50	50	0	0	0	2	0	2	100	0
15.27	0	0	0	2	1	3	100	0	0	0	0	2	0	2	100	0
16.1	0	0	0	5	0	5	100	0	0	0	1	4	0	5	80	20
16.2	0	0	0	4	0	4	100	0	0	0	1	3	0	4	75	25
16.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16.4	0	0	0	3	0	3	100	0	0	0	0	3	0	3	100	0
16.5	0	0	0	5	0	5	100	0	0	0	1	4	0	5	80	20
16.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17.1	0	0	1	2	0	3	67	33	0	0	1	1	0	2	50	50
17.2	0	0	1	2	0	3	67	33	0	1	1	0	0	2	0	100
17.3	0	0	2	1	0	3	33	67	0	1	1	0	0	2	0	100
17.4	0	0	1	1	0	2	50	50	0	0	1	0	0	1	0	100
18.1	0	0	0	5	0	5	100	0	0	0	0	4	0	4	100	0
18.2	0	0	0	8	0	8	100	0	0	0	1	4	0	5	80	20
18.3	0	0	2	218	0	220	99	1	0	0	0	231	0	231	100	0
18.4	0	0	0	2	0	2	100	0	0	0	0	2	0	2	100	0
18.5	0	0	0	5	0	5	100	0	0	0	0	2	0	2	100	0
18.6	0	0	0	1	0	1	100	0	0	0	0	1	0	1	100	0

	SUMMARY STATISTICS: 1991 - 2011															
	IMPLEMENTATION SCORES								EFFECTIVENESS SCORES							
SUMMARY	1	2	3	4	5	Total	% 4 or 5	% 3 or less	1	2	3	4	5	Total	% 4 or 5	% 3 or less
Totals by score	17	143	1000	33483	362	35,005	97	3	23	133	751	18,197	166	19,270	95	5
Scores as % of total Implemented. Evals	0.05	0.41	2.86	95.65	1.03				Total Number (N) of Implementation and Effectiveness Scores = 54,275							
Scores as % of total Effective. Evals	0.12	0.69	3.90	94.43	0.86											

Note: Includes results from BMP 2 and BMP 4 forms. BMP 2 results are only entered in effectiveness column as a "4". BMP 4 results are entered in both effectiveness and implementation columns.

Appendix E: Soil Rehabilitation Plans and Mitigations for East Reservoir Project Area

Overview

The level of detrimental soil disturbance (DSD) will depend in large part on how skid trails are laid out and properties of surface soil layers, specifically soil texture, the amount and size of rock fragments and soil moisture conditions at the time of use. Coarse textured soils and abundant rock fragments in the soils would both reduce the depth and width of detrimental soil disturbance beneath the tire or tracks of mechanical harvesting equipment. Dry soils would not become nearly as compacted as wet soils (Han et al. 2006). Whether compacted or not, the basic soil resource along skid trails would remain intact providing soil erosion is controlled.

Major Sources of DSD

Soil compaction may involve soil erosion due to rutting or inadequate erosion control on strongly sloping to moderately steep grades; potential topsoil displacement; and loss of soil productivity and surface A-horizon in old skid roads. These road/trail prisms where not rehabilitated following previous activity, typically need considerably less forest floor or soil structure re-building.

Analysis for DSD found all except four units in proposed East Reservoir Project would meet R1 SQS after implementation. Rehabilitation of soil resources ties to direction in the Kootenai National Forest Plan (KNFP), NFMA, and the R1 SQS (soil quality standards). The use of rehabilitation techniques in site-specific instances would move areas of soil disturbance towards improved site potential at a faster rate than if no rehabilitation techniques are used. It is estimated that rehabilitation would reduce soil compaction and thereby significantly enhance soil and forest floor recovery timeframes. This timeframe of recovery is more dependent on the landtype present and season of timber harvest operations as significant variables which impact soil rehabilitation success (L. Kuennen pers. comm. 2009).

Rehabilitation actions would be effective at breaking up the area extent and magnitude of detrimental soil disturbance and provide for improved aeration and hydrologic function within the soil. Rehabilitation actions start the ultimate goal of soil restoration; that is to provide the building blocks from which soil organisms and plants can continue to modify and build soil structure and chemistry. By providing these building blocks, R1 SQS are met since steps have been made to move the treatment units towards improved soil and site condition. Promoting biologic activity is the best way to remediate damaged soils (Powers 1990). Biologic activity influences many physical characteristics of the soil, e.g. soil aggregation and associated water infiltration and gas exchange as well as soil chemistry.

REHABILITATION TREATMENTS

Soil rehabilitation techniques may include either natural (passive) restoration or non-natural aggressive restoration techniques.

❖ **Natural (Passive) Restoration**

Natural (passive) restoration includes seeding/planting; scarification, treatment of noxious weeds, or a combination of techniques. Natural processes include freeze/thaw and wet/dry cycles, forest floor building and biological activity. Biological activity includes both above ground flora and fauna and soil flora and fauna. It is anticipated that all units within the East Reservoir analysis area would be exposed and influenced by natural passive restoration activities; however, the effectiveness would be dependent on varying features such as freeze-thaw cycles, soil temperatures, vegetative response units (VRUs), and local soil factors such as landtype, soil texture, aspect, slope and elevations (Kuennen and Gerhardt 1995).

Seeding or Planting

The Kootenai National Forest (KNF) has a localized seed mix that is included in each timber or stewardship contract package. Seeding or planting with shrubs or trees is recommended where noxious weeds could invade or at high value sites.

Scarification with a piece of equipment to a depth of 6-12 inches to roughen the soil surface improves seedling germination and survival by creating microsites. On areas with deep compaction, sub-soiling or other decompaction techniques to the depth of compaction improves the seedbed.

Fertilization is not recommended. Fertilization has been found to increase weed presence through changes in the soil nutrient cycles which favor fast growing opportunistic vegetation.

❖ **Non-Natural (Aggressive) Restoration**

Ripping, Sub-Soiling and other Soil Decompaction Techniques

Rehabilitation of soil compaction should be prescribed on a site-specific basis. Those units in the East Reservoir analysis area where such activities should occur in at least one of the alternatives include proposed units 194S, 194T, 330, and 331. For more depth refer to the Soils Resource analysis.

Ripping, sub-soiling, or other decompaction techniques (e.g. using an excavator bucket to pierce the soil surface) are prescribed to accelerate the recovery of compacted soils through reducing bulk density. Several types of equipment are available including rock rippers, large disks, slash-rakes, winged rippers, winged sub-soilers and excavators with specialized buckets.

The objectives for this technique are to loosen the upper (6-12) inches of soil to allow natural processes (such as root penetration, soil microbial activity, water infiltration, gas exchange, freeze-thaw cycles) to operate and restore soil function and aggregation in the rooting zone. As plants and soil organisms modify soil structure and chemistry, they continue to naturally restore soil process. By providing the building blocks through decompaction, the R1 soil quality guidelines are achieved since steps have been made to move the treatment units toward improved soil and site condition.

Ripping or sub-soiling should only be used on severely compacted soils and in relatively small areas, e.g., landings, main skid trails and temporary roads. Ripping skid trails is appropriate if trails are benched with obvious cut and fill slopes or deeply trenched with obvious outside berms can be accomplished with Timber Sale Contract Provision C(T)6.6.32# Temporary Road and Tractor Road Obliteration. Where soils contain 35% or greater rock content such activities may only be marginal in effectiveness (L. Kuennen pers. comm. 2009).

Sub-soiling done correctly does not mix soil horizons or create deep furrows, instead the winged tinges and till bars shatter the compaction. Mixing may occur if the tinges encounter large rocks or buried logs. To effectively loosen or decompact existing soil conditions, the soils need to be heavily compacted and the compaction needs to be continuous. No evidence of soil resettling on medium textured landings two years after sub-soiling was noted (Carlson 2002, monitoring observation).

Ripping and topsoil restoration on fine textured soils is challenging due to the difficulty of timing field operations to coincide with optimum soil moisture conditions. Sub-soiling significantly reduced the bulk density of soils in heavily used landings with the overall reduction of bulk density dependent on soil texture, with coarser soils showing the greatest improvements in bulk density (Plotnikoff et al. (2002). In addition to ripping, wood chips incorporated into the soil surface were found successful in reducing bulk densities (B.C. Ministry of Forests 2002, 2000).

The rehabilitation techniques are not expected to immediately reduce historic detrimental soil conditions. However, by breaking up the subsurface compaction, natural processes (such as root penetration, soil microbial activity, water infiltration, and freeze-thaw cycles) will be accelerated and will be more capable of returning the soil to pre-disturbance condition. Within a 5 to 10 year timeframe, the rehabilitated soils are anticipated to more closely resemble the reference condition. The soil productivity of the unit will be improved from its current condition.

The analysis of this project assumes that 50% of historic skid trails in ground based units would be reused for units containing 8% or greater existing DSD values. Thus for all such units the statistical average of percent DSD was reduced by half to determine an estimated cumulative effects value on a unit-by-unit basis.

Organic Matter Placement

Placing slash on old and new skid trails and leaving slash of various sizes throughout the activity area would occur in conjunction with conventional erosion control measures required under the Timber Sale contract. Such activities are suggested to occur where the greatest impacts to soils dominantly occurs as a result of skid trail convergence (typically lower 25% of harvest unit). Such activities are the best way to promote biological activity and reduce soil compaction. Placement of slash on a landing or skid trail would: 1) decrease erosion through the creation of microsites; 2) decrease the amount of surface sealing (caused when mineral soil is exposed to rain); 3) provide shade and associated soil moisture; 4) provide germination substrates and microsites that encourage native species while deterring weedy species; and 5) increase biologic activity and all associated benefits. Such activities are proposed for East Reservoir Units 194S, 194T, 330, and 331. Additionally, such activities should also be used in units with proposed ground based operations that are near a cumulative value of 15% DSD. This includes units : 2, 2B, 3, 7, 10, 13, 14, 15, 24, 26, 64, 70T, 73T, 74T, 80, 81, 159A, 183, 190, 190A, 194T, 196, 305, 307, 311, 318, 319, 327, 328, 330, 331, 334, 335, 339, 340, 344, 345, 346, 347, 349, 350 and COE6.

Placing slash on skid trails for erosion control and soil rehabilitation can be effective as it provides a physical buffer between raindrop energy and the bare soil surface. It also reduces soil sealing, raindrop slash soil particle detachment, and provides roughness and microsites for the settling and storage of any soil movement. In addition, placing slash on skid trails improves soil productivity by providing fines to the bare forest floor ameliorating (lessening) soil heating, providing microsites for plant establishment, and improving soil water retention. Where available such activities would aid in increasing the biological resiliency and native plant re-establishment.

Suggested Slash Depth and Coverage (Erosion Control, Site Amelioration)

- Place slash (all size classes, both <3" and greater than 3") in conjunction with erosion control measures on all sites where material is available. Ensure contact with the soil surface. Measure coverage at the time of placement. The retaining tons of woody material is dependent if harvest prescription is regeneration harvest operations and what the VRU is for that timber stand (refer to soils Table 10 of Soils report).

Landing Rehabilitation

In contrast to temporary roads, landings do not generally require cut and fill operations provided they are correctly sited. Selection of a relatively flat area is the prime consideration.

Abundant rock fragments in surface soil layers also reduce the overall level of soil compaction. In some instances, the presence of grassland vegetation in an area may indicate soil conditions that make sites unsuitable for use as landings. Examples include: areas of shallow groundwater (wet soils), or heavy clay soil textures.

Burning of large slash piles on a portion of the landing has the potential for creating DSD immediately below the pile due to severe burning. In extreme cases, this could reduce long-term soil productivity of the mineral soil resource itself due to changes associated with extremely high soil temperatures. Loss of organic substrates and coarse woody debris are the most obvious impacts of burn piles. These would likely be temporal impacts and in most cases can be mitigated. Unlike extreme wildfires, burned areas under slash piles are isolated from adjacent burned areas. While significant soil impacts occur at landings, the topsoil resource remains largely intact so long as adequate erosion control is provided.
In order to minimize the effects from landing construction and burning of landing slash, the following

design features and mitigation measures will be incorporated into the timber sale contract.

Constructed landings should be rehabilitated on a unit specific basis as soon as possible by the purchaser if the timber sale is still active by doing the following:

- Spread larger woody material on landing where available following harvest activity.
- Machine-scarify the soil surface to improve moisture drainage characteristics in areas of high intensity burns where soils contain hydrophobic conditions. Depending on soil texture, access, and existing recovery levels, the landing could be sub-soiled or ripped. Avoid turning the soil. Recontour previously excavated and graded material back across the landing site to re-establish natural contours. Re-spread the surface soil back over the scarified or re-contoured landing.
- Seed with grasses and forbs or plant shrubs/trees on the site (per C6.601 – Erosion Control Seeding).
- Note that currently the FS normally burns landings following harvest operations. If available such activities could be funded through KV funds to treat landings following harvest operations if the purchaser is no longer available and the sale has closed. Where the purchaser is responsible for treating burned landing area – purchaser would have to burn landing.

Skyline Corridor Rehabilitation

Skyline corridor concerns may be present on a site-specific basis in areas of concern due to a lack of single-end suspension or deflector problems. In such areas the exposed mineral soil should be water-barred (B(T)6.65 – Skid Trails and Fire Lines), seeded and fertilized (C(T)6.601 – Erosion Control Seeding). In lieu of (or in conjunction with conventional EC measures) water-barring in some cases, erosion control measures involving slash placement on exposed mineral soil areas can be more effective at reducing erosion. Such activities apply to Unit 194S.

Road Intermittent Stored Service

Following the KNF Intermittent Stored Service/Decommissioning Policy, the roads listed in Tables 2.9 and 2.21 (DEIS, Chapter 2) would be placed in Intermittent Stored Service (ISS). The identified roads would be placed in a condition that there is little resource risk if maintenance is not performed (FSH 5409.17-94-2).

Closure of Temporary Roads

Many factors can affect the actual level of DSD created at landings or along temporary roads. These same factors determine both the suitability and effectiveness of different mitigation procedures. For temporary roads, it is assumed that some blading of the road bed would occur prior to the start of harvesting and that trees along the road corridor would be tipped over and removed, root ball and all. Topsoil loss would be the major concern. Topsoil displacement and mixing with underlying subsoil is inevitable. Not all of the topsoil resource would be lost, however, as much of it would just be redistributed to the downslope side of the road. Soil compaction and loss of organic substrates are also issues along temporary roads. Despite a lot of attention, these are secondary and more short-term concerns on temporary roads than potential topsoil loss.

Factors affecting the level of DSD created along temporary roads include steepness of the terrain, soil texture and the amount of rock fragments in both the topsoil and underlying subsoil horizons, as well as the depth of blading. Within the constraints of suitable road construction standards, depth of blading should be minimized to the extent practical during road construction if maintaining soil productivity within the road corridor is a consideration.

The degree of lost soil productivity in the road corridor would often depend on differences in soil properties of topsoil layers relative to underlying subsoil. If little difference exists, both are good or both are poor, then changes in soil productivity would be limited. If there are dramatic differences in soil chemical and/or physical properties between topsoil and subsoil layers, then loss of topsoil layers would result in a significant loss of soil productivity. If the primary difference between topsoil and subsoil is in

the amount of soil organic matter and organic substrates, then lost soil productivity may be dramatic at the start but would recover over time. In soils that are shallow or very shallow over bedrock, removal of the topsoil layer would result in permanent loss of soil productivity.

Table 1 provides a listing of those harvest units where temporary road scarification would be required on a unit-by-unit bass in at least one of the proposed alternatives of the East Reservoir analysis area. Such concerns can be addressed on a unit specific basis by scarification and seeding the road prism and pulling slash material onto the temporary road prism where present. Such activities would occur on all temporary road prisms by the contractor when harvest activities are completed.

Table 1 - Calculated DSD Related to Temporary Road Construction

TEMPORARY ROAD #	LENGTH (miles)	UNIT #	UNIT ACRES ALT 2/ALT 3	ROAD DSD by UNIT (ac) Alt 2/Alt3	% DSD RELATED to TEMPORARY ROAD by UNIT ALT 2/ALT3
T5	0.2	17	68/68	0.4/0.4	<1/<1
T6	0.4	22	83/83	0.8/0.8	1/1
T14	0.1	318	131/0	0.2/0	<1/0
T25	0.5	31	698/698	1.0/1.0	<1/<1
T25	0.1	197	24/24	0.2/0.2	1/1
T28	0.4	345	45/45	0.8/0.8	2/2
T37	0.1	340	266/266	0.2/0.2	<1/<1
T42	0.2	362	192/0	0.4/0	<1/0
T43	0.3	362	192/0	0.6/0	<1/0
T42	0.2	362B	0/40	0/0.4	0/1
T43	0.3	362C	0/39	0/0.6	0/2
T44	0.2	150	103/40	0.4/0.4	<1/1
T45	0.3	49	64/64	0.6/0.6	1/1
T53	0.4	148	77/40	0.8/0.8	1/2
T54	0.2	344	73/64	0.4/0.4	1/1
T55	0.3	343	100/93	0.6/0.6	<1/<1
T57	0.3	23	146/146	0.6/0.6	<1/<1
T58	0.2	179	76/0	0.4/0	1/0
Alt 2	**4.3**			**8.6**	
Alt 3	**4.1**			**8.2**	

^Road length rounded to the nearest tenth of a mile.
*Only those units where new temporary road construction would be required are listed above.

Temporary roads and landings locations and construction standards for the sale(s) would be agreed upon by the Forest Service (FS) and purchaser. These areas would be constructed and used in adherence to BMPs and RHCAs to minimize their impacts to soils. Instances where a controlled temporary road location is desirable, timber sale contract provisions C(T)5.1 (Construction of Temporary Roads in Sensitive Areas) and/or C(T)5.102 (Construction of Temporary Roads) may be used.

Prevention versus Rehabilitation

The results of a study completed by Rawinski and Page (2008) and Powers and others (2005) indicate that sites with low recovery rates were sites located in frigid temperature regimes. These studies concluded that perhaps freeze-thaw cycles in cool, temperate and boreal life zones are not particularly effective of ameliorating the impact of soil compaction below 10 cm. As a result, prevention of soil compaction is generally preferred over restoration measures. Careful design and spacing of skid trails can keep soil impacts within soil standards. Winter logging on snow or frozen conditions can also minimize soil impacts. Alternatively, operating on dry soil conditions can be useful in managing soil impacts. Use of a winged subsoiler to ameliorate soil compaction concerns can bring areas considered detrimentally disturbed and exceeding the 15% DSD threshold back down to and below the threshold levels for both aireal extent and compaction.

Unit Specific Rehabilitation Plan
Analysis for DSD found all units except proposed commercial thin Units 194T, 194S, 330, and 331would meet R1 SQS after implementation. Regarding Units 3194T, 194S, 330, and 331 the existing measured DSD value was found to be 14% (2010-2011 soil surveys). As a result, the post-harvest cumulative DSD values were all found to exceed 15% DSD values. Based on these values the restoration goal for these units will be to return the soils back to 15% or lower DSD levels within a 3-year timeframe following harvest activities. These activities are described below. Where post-harvest DSD values are calculated to exceed 15% project design standards includes incorporating slash material during skid trail scarification and lay-back in proposed harvest units. In these units, slash would be placed by the purchaser as part of timber harvest contract requirements to control erosion and provide organic matter for forest floor function.

Rehabilitation of soil resources ties to direction in the KNFP, NFMA and the R1 SQS. The use of rehabilitation techniques in site-specific instances would move areas of soil disturbance towards improved site potential at a faster rate than if no rehabilitation techniques are used. It is estimated that rehabilitation would reduce soil and forest floor recovery to approximately 20-40 years. Without rehabilitation, recovery of soil and forest floor process and function would be expected to take greater than 40 years.

Skid Trails
Skid trails have a much lower level of proportion of detrimental soil disturbance than either temporary roads or landings. They are also more likely to recover over time providing adequate erosion control measures. The amount of material being removed from a stand would determine how many trips would be made along skid trails. Fuel treatments require fewer trips than clearcutting. In general, fewer trips means less DSD although some research indicates that most of the soil compaction occurs the first couple of passes of equipment (Han et al. 2006).

Under timber sale contract provision C(T)6.4# (Conduct of Logging) re-use existing skid trails where possible and feasible. Upon completion of harvest the contractor would obliterate skid trails and rehabilitate landings in order to reduce the detrimental soil disturbance values over time include Units 17, 22, 23, 31, 49, 148, 150, 179, 194T, 194S, 197, 318, 330, 331, 340, 343, 344, 345, 362, 362B, and 362C (refer to Soils Resource Report).

Soil Recovery Trends on the KNF following harvest operations
Currently a research study is on-going which is subjectively comparing post-harvest soil disturbance values with re-sampled unit DSD calculations. This study has just began in the spring of 2012 but has already displayed remarkable decreases in currently existing DSD values as compared to what was sampled by L. Kuennen between 1992-2006.

Season of Operation and Impact on Soils

Requirements
The KNF identified a number of units in the East Reservoir analysis area where soils, weed species and/or archeology are a factor of concern. As a result these units are recommended for winter harvest operations to reduce potential impacts.

Winter Tractor Based on Archeology
The East Reservoir analysis area contains two units where winter operations are required based on archeology concerns. These are proposed harvest Units 1 and 1A. This is required based on the fact that harvest of these units during the winter season is less likely to disturb existing historical sites. As a result, it is expected that the DSD results associated with harvesting Units 1 and 1A will be 50% of what is expected during summer operations under both Alternatives 2 and 3.

Winter Tractor Based on Noxious Weeds
An additional restoration activity would be the treatment of weeds in the project area, primarily on

landings and roads. The presence of noxious weeds alters vegetative cover and soil stability especially on droughty soils. Knapweed on droughty soils effectively reduces the cover of native plant species through allelopathic chemicals and the plant itself does not provide good soil cover or rooting structure. Treating noxious weeds would increase soil productivity over the long-term, greater than five years. One of the best ways to treat noxious weeds is through avoidance of spreading. Such activities can be accomplished by harvesting during winter seasons. This is also expected to benefit soils and reduce soil compaction by operating heavy equipment on frozen soils. Such conditions lead to significantly lower over DSD as a result of harvest activities. As a result the following units will be winter harvested based on weed concerns: 2C, 2D, 3A, 9, 11, 17, 28, 157, 158, 158A, and 306. As a result, it is expected that the DSD values will be 50% of what is expected during summer operations.

Winter Tractor Units Based on Soils

Post-harvest soil monitoring data collected from the KNF (1992-2012) has displayed an overall reduction of approximately 50% in DSD when comparing winter tractor to summer tractor operations. As a result it was determined for those units with currently existing higher DSD values to propose such units be harvested in the winter season on frozen grounds. The following units were identified as winter tractor operations: 2, 2B, 3, 7, 10, 13, 14, 15, 24, 26, 64, 70T, 73T, 74T, 80, 81, 159A, 183, 190, 190A, 194T, 196, 305, 307, 311, 318, 319, 327, 328, 330, 331, 334, 335, 339, 340, 344, 345, 346, 347, 349 and 350.

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Appendix H: Forest Plan Standards and Guidelines

Kootenai National Forest Plan/INFS
Prior to 1995 the Forest Plan contained only qualitative direction, which could be used to measure existing fisheries habitat conditions or possible effects of management activities on populations or habitat (discussed below). In 1995 standards and guidelines were developed through the Inland Native Fish Strategy (INFS). This strategy is intended to provide interim direction for forest management on National forests, including the Kootenai. The purpose of INFS is to maintain options for native fish by reducing the risk or loss of populations and reducing potential negative impacts to aquatic habitat.

Goals and Objectives (II -1 thru II-12)
The goals outlined in the Forest Plan include; Construct and reconstruct roads only to the minimum standards necessary to prevent soil loss and maintain water quality. Meet or exceed State water quality standards.

In order to accomplish these goals the following objectives were identified:

Timber
The amount of timber harvest allowed will depend on the rate of hydrologic recovery after timber has been removed. The soil and water conservation practices specified in FSH 2509.22 will be applied during Forest Plan implementation to ensure that Forest water quality goals are met.

Soil and Water
Ground disturbing activities such as road construction, road reconstruction, and timber harvest will be accompanied by mitigating measures to prevent or reduce increases in sedimentation and stream channel erosion. The amount of timber harvest allowed will depend on the rate of hydrologic recovery after timber has been removed. Soils and water conservation practices as outlined in the Soil and Water Conservation Practices Handbook (FSH 2509.22) or those activities or standards, which will prevent or reduce stream sedimentation will be implemented. Examples include; location of roadbeds out of stream bottoms, design of stream crossing structures to allow water to freely pass, rock surfacing of roads at stream crossings, keeping equipment from operating in or alongside streams, and maintenance of roads to allow proper drainage. These practices will be implemented in order to maintain water quality. Each project plan for which the use of heavy equipment is required shall evaluate the effect of operating that equipment on soil productivity.

Riparian Areas
Site specifically identify and map all riparian areas on the Forest before project activity.

Forest Plan Standards
Protect and maintain important riparian zone features, marshes, and water bodies.

Soil and water conservation practices as outlined in the Soil and Water Conservation Practices Handbook (FSH 2509.22) will be incorporated into all land use and project plans as a principal mechanism for controlling non-point pollution sources and meeting soil and water quality goals and to protect beneficial uses. Activities found not in compliance with the soil and water conservation practices or State standards will be brought into compliance, modified or stopped.

A floodplain/wetlands analysis will be made for all management actions involving wetlands, streams, or bodies of water.

Each project plan for which the use of heavy equipment is required shall evaluate the effect of operation that equipment on soil productivity as described in the Soil and Water Objectives portion of the KNFP.

Projects involving significant vegetative removal will, prior to including them on implementation schedules, require a watershed cumulative effects feasibility analysis to ensure that water yield or sediment will not increase beyond acceptable limits. The analysis will also identify opportunities, if any exist, for mitigating adverse effects on water-related beneficial uses.

Riparian Areas (II-28 thru II-33)
The goal for riparian area management is to manage the vegetation to protect the soil and water resources and to provide high quality water and fisheries habitat.

Riparian Area Standards
Assure that there are streamside timber stands to provide for log and debris recruitment necessary for sufficient pool development and organic energy (organic debris) into the aquatic ecosystem.

Identify the riparian areas in each allotment that domestic livestock can use. Prevent livestock use of other than permitted segments of riparian areas.

Simultaneous openings resulting from timber harvest on both sides of a stream are not permitted, unless the results can be shown to be an enhancement for the riparian area.

Dozer scarification and landings are not permitted in riparian areas unless the results can be shown to be an enhancement of the riparian area.

Special uses, rights of way and cost share roads are permitted and riparian area management objectives will be incorporated into all agreements and permits.

Roads that parallel streams will be located at a distance determined by sediment transport models, and outside the 100-year floodplain.

When funds for road maintenance are limited, roads and drainage structures in riparian zones will be a top priority.

Necessary stream course crossings will insure fish passage, non-erosive water velocities and channel stability, and insure erosion control on cuts, fills and road surfaces.

Road closures will be used to protect the riparian habitat and values.

Inland Native Fish Strategy (INFS)
INFS includes eight riparian goals listed below that establish the characteristics of healthy, functioning watersheds, riparian areas, and associated fish habitats. Also included in INFS are interim riparian management objectives (RMO's) (discussed on page 8 of this report) that are indicators of ecosystem health, are quantifiable, and are subject to accurate repeatable measurements. In order to reach the goals of INFS standards and guidelines (Appendix 1 of this report) are outlined which apply to riparian habitat conservation areas (RHCA's) and to projects and activities in areas outside RHCA's that would degrade RHCA's. All activities occurring on Forest Service lands are required to meet the standards and guidelines outlined in INFS.

Since the quality of water and fish habitat in aquatic systems is inseparably related to the upland and riparian areas within watersheds, these goals were established to maintain or restore watershed, riparian and stream channel conditions including:
1. Water quality
2. Stream channel integrity, channel processes, and the sediment regime under which the riparian and aquatic ecosystems developed.

3. Instream flows to support healthy riparian and aquatic habitats, the stability and effective function of stream channels and the ability to route flood discharges.
4. Natural timing and the variability of the water table elevation in meadows and wetlands.
5. Diversity and productivity of native and desired non-native plant communities in riparian ecosystems.
6. Riparian vegetation to: provide an amount and distribution of large woody debris characteristic of natural aquatic and riparian ecosystems; provide adequate summer and winter thermal regulation within the riparian and aquatic zones; help achieve rates of surface erosion, bank erosion, and channel migration characteristics of those under which the communities developed.
7. Riparian and aquatic habitats necessary to foster the unique genetic fish stocks that evolved within the specific geo-climatic region.
8. Habitat to support populations of well distributed native and desired non-native plant, vertebrate and invertebrate populations that contributes to the viability of riparian dependent communities.

Riparian Management Objectives (RMO's)
The Inland Native Fish Strategy identifies 6 parameters (RMO's) using stream inventory data for pool frequency, large woody debris, bank stability and lower bank angle, width to depth ratio, and water temperature. These objectives have been determined to be good indicators of ecosystem health and represent a good starting point to describe the desired condition for fish habitat. These RMO's for stream channel conditions provide the criteria against which attainment or progress toward attainment of the riparian goals are measured. Actions that reduce habitat quality, whether existing conditions are better or worse than objective values, would be inconsistent with the purpose of this interim direction (INFS EA, pg E-3).

# of Pools - Pool frequency has been identified as the key feature in meeting the life history requirements of fish communities inhabiting a watershed. Pools are the least common stream habitat component in a watershed. They are also sensitive to non-point land use effects. Most fish species use pools at some stage in their lifecycle, and pools are particularly important as extreme low-flow refuge habitat. Pools are bowl shaped depressions in the stream channel where the stream surface is nearly flat. The desired pool frequency varies by channel width with larger stream channels having fewer pools.

 # Pieces Large Woody Debris - large woody debris (LWD) in forested streams is critical to habitat composition and cover for fish populations. It is important in pool formation, channel bank stability, fine sediment and gravel storage, and organic nutrient storage (USDA Forest Service, 1994b). A decrease in LWD can have major effects on these physical habitat parameters. Channel and bank instability resulting from decreases in LWD can have a direct effect on survival of some juvenile salmonids during peak flow events (Reimer and McIntyre 1993). Loss of habitat formed by LWD reduces overwinter survival of fish. LWD also creates structure for storing spawning gravel. Reduction in LWD could result in less spawning area and decreased natural production. In addition, nutrient stored in the fine sediment trapped by the LWD and the wood itself is used by macroinvertebrates which are a food source for fish (USDA Forest Service, 1994b).

LWD is the tree stems that are (or will be) part of the stream channel structure. Woody debris comes in four varieties, fine particulate matter being transported by the streamflow, coarse particulate matter that is temporarily stored on the stream bottom (leaves and stem fragments), small woody debris (stems) that are larger than 4" at its largest end and large woody debris that is larger than 6" at its largest end. The desired situation and that which was used to measure large woody debris would be 1 piece, >12" in diameter, and greater than 35' long, every 250 feet of stream length.

Bank (channel) Stability - bank stability looks at the stability of streambanks rather than the whole channel. This is different than the Pfankuch channel stability procedure used for many years in determining water yield increases on the Kootenai, although the relative condition of the stream channel would be considered similar with either measurement. Fisheries research has found that the channel

stability survey has enough bias and variability in it that fish abundance is not related to that estimate. A variety of species use streambanks as cover at some time of the year. By measuring this habitat element, we directly measure hiding cover availability and indirectly approximate the availability of other types of cover that disappear as streambanks erode and send sediment downstream. Stream channel stability is determined from observation of a series of channel parameters and given a numerical rating based on those observations. Channel stability for a given stream reach for that particular set of parameters is then determined as fair, good or poor. By using both bank and channel stability measurements we are able to identify weak links in the stream system. The percent stable banks has a desired level of 80 percent.

Stream Temperature - temperature is a major factor affecting fish survival, distribution, production, and community composition in forest streams of the Pacific Northwest0 (Beschta et al. 1987). Elevated temperatures from exposed riparian areas are expected to increase summer daily temperatures. What we want to know is whether a stream is near or above the thermal maximum for coldwater biological communities or whether there is an extreme range in temperatures over the course of several days. INFS recommends no measurable increase in maximum water temperature (7 day moving average of daily maximum temperature measured as the average of the maximum daily temperature of the warmest consecutive 7 day period). Maximum water temperatures below 59 degrees within adult holding habitat and below 48 degrees within spawning and rearing habitats.

Width/Depth Ratio - There are two Rosgen channel types that naturally meet the standards identified in INFS for this parameter. Types B and C have a width/depth ratio greater than 12. These RMO standards need to be adjusted to match geomorphic stream types and not attempt to make all streams fall into a single category this will better match conditions on the Kootenai National Forest.

Riparian Habitat Conservation Areas (RHCA's)

RHCA's are portions of watersheds where riparian dependent resources receive primary emphasis and management activities are subject to specific standards and guidelines. RHCA's include traditional riparian corridors, wetlands, intermittent streams and other areas that help maintain the integrity of aquatic ecosystems by (1) influencing the delivery of coarse sediment, aquatic matter, and woody debris to streams, (2) providing root strength for channel stability, (3) shading the stream and (4) protecting water quality (Naiman et al. 1992). In order to reach the goals of INFS, standards and guidelines are outlined which apply to RHCA's and to projects and activities in areas outside RHCA's that would degrade them.

APPENDIX I: EAST RESERVOIR MONITORING PLAN

RESOURCE	OBJECTIVE	TIMING	METHODOLOGY	RESPONSILBLITY
Forest Vegetation	Monitor silvicultural prescription implementation	After project implementation	Check all units following harvest to document existing condition, and recommend future stand treatment needs	Silviculturist
Forest Vegetation	Ensure reforestation success	After project implementation	Monitor all regeneration units for reforestation success.	Silviculturist
Soils	Ensure compliance with R1 soil quality standards	During the life of the timber sale	Monitor harvest units for compliance with R1 soil quality standards as described in the KNF Plan Monitoring and Evaluation Report for Fiscal Year 2011 (Project File).	Soil Specialist
Fuels	Ensure the fuel treatments are effective	After project implementation	Monitor the fuel treatments on a minimum of 10% of the units to ensure objectives are met.	Fuels Specialist
Botany	Ensure viability for sensitive plants, particularly Taper-tipped onion	Through the prescribed burning covered in project	Monitor the effect of weed control and burning on rare plant populations. Monitor overall weed control efforts. Monitor status of sensitive plants within the project area during and after treatments.	Botanist
Wildlife #1	Collect reserve tree and snag numbers	During the marking of the regeneration units that require leave tree marking	Conduct a representative sample of units within each VRU (2 units in each VRU represented in the Analysis Area). This item would provide baseline numbers for monitoring items #2 and #3 below. The timber marking crew would tally snag and reserve tree numbers during marking, and only in those regeneration harvest units with leave tree marking.	Timber/Pre-Sale Marking Crew
Wildlife #2	Monitor snag retention	After harvest and site-preparation has occurred, but generally within five years from end of harvest.	Within those regeneration harvest units surveyed in #1(above) to determine if snag management strategies are meeting Forest Plan cavity habitat direction. Work would be completed concurrent with reforestation surveys.	Silviculture Crew
Wildlife #3	Monitor reserve tree retention within those regeneration harvest units surveyed in #1 (above).	After harvest and site-preparation have occurred, but generally within five years from the harvest.	Maintenance of reserve trees insures that future cavity-nesting habitat and down woody recruitment are available to help provide future denning, feeding, and nesting habitat. Work would be completed concurrent with reforestation surveys.	Silviculture Crew
Wildlife #4	Monitor the changes created by vegetative treatments on the attributes of old growth in treatment units	Pre-treatment surveys. Two post-treatment surveys, at one and five years.	Conduct pre- and post-treatment surveys to collect vegetation data on a representative sample of units. Data must, at a minimum, include snags, coarse woody debris, large trees, basal area, canopy closure, and structural layers (Green et al 1992). Conduct these surveys to collect vegetation data using the common stand exam process. Data collected by the Common Stand Exam has broader application both forest and region	District Silviculturist, Fire Management Officer

RESOURCE	OBJECTIVE	TIMING	METHODOLOGY	RESPONSILBLITY
			wide.	
Hydrology	Ensure continued stream function, stability, and high water quality	After project implementation	Resurvey all Rosgen Level II and KNF Level III Fish Habitat sites in East Reservoir analysis area.	Hydrologist
Hydrology	Implementation and effectiveness of applicable BMPs.	During and immediately following project activities.	BMP inspection reports and/or Timber Sale Inspection Reports. Inspection reports would be completed as part of the annual district BMP effectiveness monitoring program.	Timber Sale Administrator, Engineering Representative/COR, Hydrologist, IDT.
Hydrology	Ensure continued stream function, stability and high water quality.	On going	Monitor TSS and discharge at the USGS site.	Hydrologist
Hydrology	Monitor protection and management of stream channels, riparian areas, and riparian habitat conservation areas during timber harvest and road reconstruction.	During implementation of activities that occur in or near riparian areas or wetlands.	This monitoring would occur as a fundamental component of timber sale administration.	Timber Sale Administrator, Engineering Representative/COR, District Hydrologist
Hydrology	Monitor success of revegetation efforts on disturbed sites.	During initial seeding and the years following	Field inspection of seeded sites at the close of the sale and 2 to 3 years after the sale. Additional seeding would then be done if the success rate is low.	Timber Sale Administrator, District Hydrologist
Hydrology	Water quantity and quality monitoring.	On going	Field collection of stream flow, temperature, and suspended sediment samples, following USGS protocols	District Hydrologist
Hydrology	Channel geometry monitoring to assess trends in channel condition	Every three to five years for sites within the planning subunit	Repeated cross-section and channel geometry surveying in designated and monumented reaches	District Hydrologist
Weeds	Noxious weed control	On going	Monitor/survey the project area for new invader weed species. Monitor weed population levels in treated areas, with particular emphasis on haul routes, stored roads, and landings. Pre- and post-activity surveys for areas scheduled for burning	Weed Specialist, Botanist
Recreation	Ensure compliance with road/trail closures.	On going	Bi-annual monitoring of motorized vehicle closure devices and effective closure of ATV trespass trails.	Recreation Specialist

Appendix J: Dunn Creek Sedimentation Investigation Report
- 2011-

Sediment source within the Canyon Reach of Dunn Creek

US Department of Agriculture
Kootenai National Forest
Libby Ranger District

July 26, 2011

Dunn Creek Sediment Investigation Report
- 2011 –

Prepared For:
USDA Forest Service
Libby Ranger District
East Reservoir E.I.S.

Prepared By:
Josh Boyd
USFS Hydrologic Technician
Libby Ranger District
12557 Hwy 37
Libby, MT 59923

Dunn Creek Sediment Investigation Report

Hydrology

Dunn Creek is located in the Middle Kootenai Basin approximately 2 miles downstream of Libby Dam. This watershed is 33.85 sq. miles in size and is composed of 1st, 2nd, 3rd, and 4th order drainages. There is one dominant perennial channel to this system, the mainstem of Dunn Creek with other tributaries feeding into it. These include Snag Gulch, Wyoma Creek and a sizable unnamed tributary.

Aspects throughout the basin are predominantly low energy, low elevation with the main basin draining to the northwest. Upland slopes of 35 -40% exist on the south side of the drainage and 15-20% on the north side. Elevations in the area vary from 6,000' to 2,120' at the mouth of Dunn Creek.

A bankfull flow of 125 cubic feet per second (cfs) has been validated at a permanent gaging station at the mouth of the drainage. The estimated Q2 return interval has been estimated at roughly 143 cfs using USGS Flood Frequency and Basin- Characteristic Data.

Climate

Like most of the Kootenai National Forest, the contemporary climatic conditions for Dunn Creek are a combination of continental and maritime influences. The maritime patterns originate primarily from the flow of warm, moist air masses from the west and the Pacific Ocean. One result is the gentle, steady, "soaking" rains in the fall and winter which are typically accompanied by cloudy skies with small diurnal temperature changes. The summers are typically warm and dry, with significant cooling at night. The predictable summer dry season, usually occurring sometime in July and August, is a defining characteristic of the local, temperate climate. Continental effects are reflected in occasional cold periods in the winter, typically associated with northerly or arctic weather systems, and the hot, dry summer periods associated with high-pressure systems. These overlapping climatic provinces often create "rain-on-snow" events in the late fall and winter, when two to three days of continuous rain falls on a snowpack causing flooding. The precipitation for Dunn Creek ranges from 14 to 40 inches annually. At the upper elevations, the majority of this precipitation comes in the form of snow between late October and late March.

Bank Erosion and Sediment Loading

The bank condition evaluation utilized the BEHI method (Rosgen, 2008) and data including bank length, average bank height, bank condition, bank materials (clay, sand, gravel, cobbles, and boulders), vegetation type and density, Near Bank Stress (NBS) and land use were collected. The BEHI method incorporates this data into numerical ratings such as bank height/bankfull height ratio, root depth/bank height ratio, root density percent, bank angle, and percent surface protection. Combined, these ratings generated a cumulative rating that provides a qualitative erosion severity assessment (very low to extreme). Actual measured bank erosion rates within the Blackfoot River drainage were used to calibrate these ratings (based on similar geology and stream types), and allowed the formulation of current bank erosion within the Dunn Creek Watershed (Table 1).

Table 1. Bank retreat rates and erodibility variables applied to Dunn Creek derived from data collected in the Blackfoot River drainage (MT). The yearly bank retreat rates in Table 1 as well as the field obtained BEHI data were input into the RIVERMorph Software™ where annual sediment loads by site and reach were derived.

ERODING BANK CONDITION RATING	BANK RETREAT RATE (feet/year)	BANK HEIGHT/BANKFULL HEIGHT	ROOT DEPTH/BANK HEIGHT	ROOT DENSITY (%)	BANK ANGLE (DEGREES)	SURFACE PROTECTION (%)
Very Low	**0.10**	1.0 - 1.1	1.0 - 0.9	100 - 80	0 - 20	100 - 80
Low	**0.17**	1.11 - 1.19	0.89 - 0.5	79 - 55	21 - 60	79 - 55
Moderate	**0.23**	1.2 - 1.5	0.49 - 0.3	54 - 30	61 - 80	54 - 30
High	**0.31**	1.6 - 2.0	0.29 - 0.15	29 - 15	81 - 90	29 - 15
Very High	**0.39**	2.1 - 2.8	0.14 - 0.05	14 - 5	91 - 119	14 - 10
Extreme	**0.47**	> 2.8	< 0.05	< 5	> 119	< 10

Bank Erosion Hazard Index (BEHI)
Streambank erosion can be traced to two major factors: stream bank characteristics (erodibility potential) and hydraulic/gravitational forces (Rosgen 1996). The principal processes of stream bank erosion within Dunn Creek include: surface erosion, soil-fall and rotational mass failure (cutbank), and fluvial entrainment (particle detachment by flowing water, generally at the bank toe). The banks represented here are not a total of all banks within the watershed. It is a combination of active yet stable banks combined with the most unstable banks within the Dunn Creek drainage.

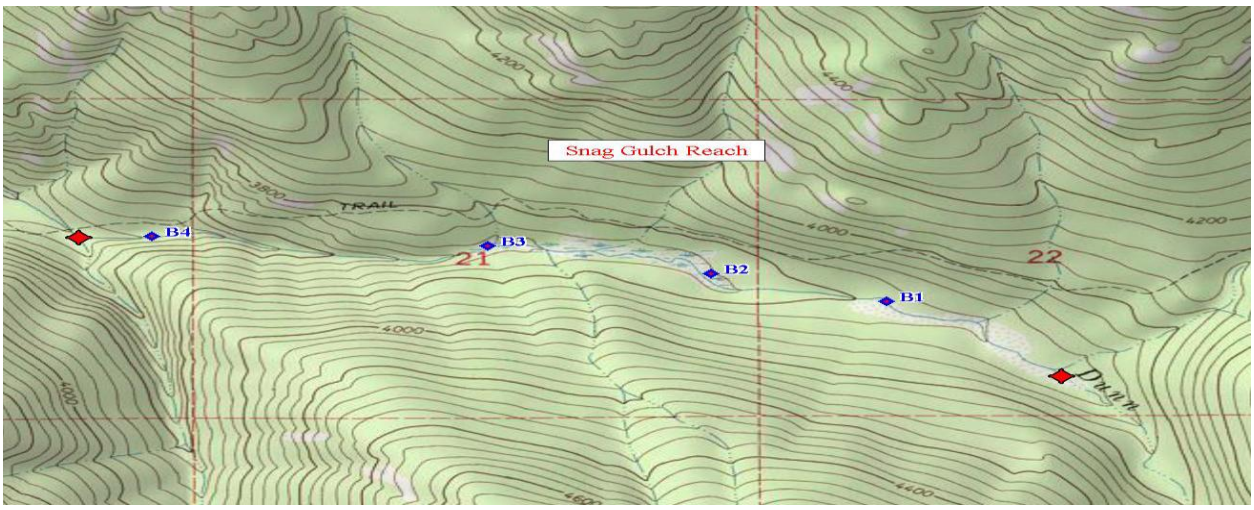
-Snag Gulch Reach-
The Snag Gulch Reach is located in the headwaters of the mainstem of Dunn Creek. It is a Valley Type II with moderate relief, stable side slopes, and floor slopes of less the 4% (Rosgen, 1996). The middle of the reach has a very flat slope with sinuous channel types of C4 and E4. The upper flat valley bottom is held in place with a high gradient section with boulders and bedrock intrusions with associated channel types of B3 and B2a. The reach break is at the confluence of the mainstem of Dunn Creek and a major unnamed tributary.

Bank erosion was calculated at 4 different sites within the Snag Gulch Reach. All BEHI and NBS were rated at Low to Moderate. The sites measured banks ranging from 3 - 4.5 ft in height contributing 0.035 tons/year/linear ft. The principal process of stream bank erosion within the Snag Gulch Reach is fluvial entrainment. With adequate vegetative cover and sufficient bank armor these are not a significant source of sediment in the basin.

Table 2. Bank erosion by site within the Snag Gulch Reach of Dunn Creek.

BANK NUMBER	BEHI NUMERIC RATING	BEHI ADJECTIVE RATING	NBS ADJECTIVE RATING	LENGTH (FT)	LOSS CU YDS/YR	LOSS TONS/YR
1	16.6	Low	Moderate	29	0.64	0.83
2	15.3	Low	Low	33	0.91	1.18
3	34	High	Low	10	0.42	0.55
4	29.6	Moderate	Moderate	23	0.63	0.82
TOTAL				95	2.6	3.38

Map 1. Snag Gulch Reach of Dunn Creek.



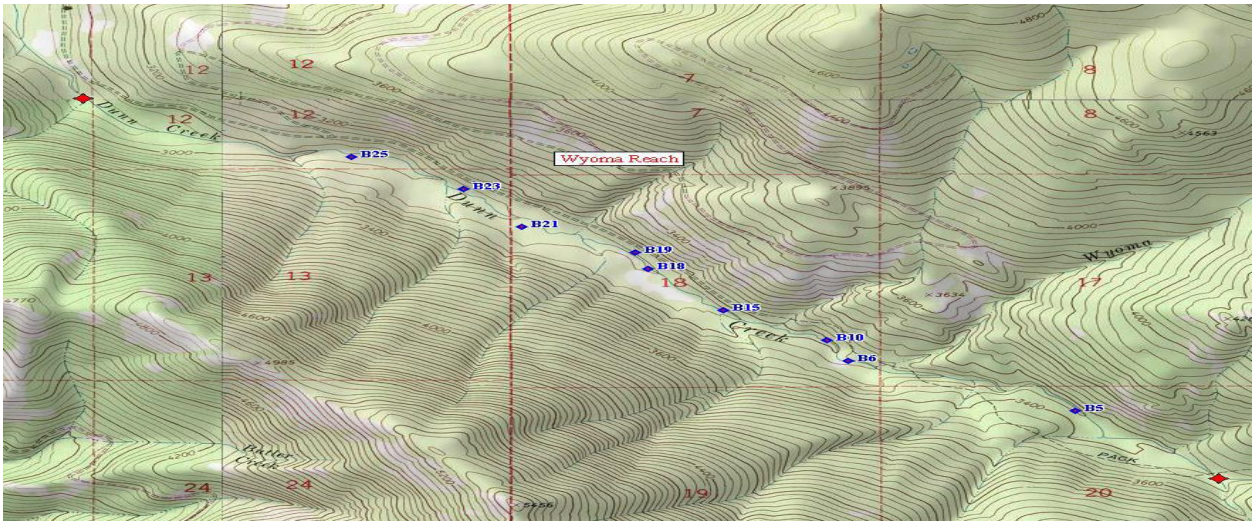
-Wyoma Reach-
The Wyoma Reach is located downstream of the confluence of the mainstem of Dunn Creek and the largest unnamed tributary. It ends at a natural narrowing of the valley mid-way down the drainage. It is a

Valley Type II with moderate relief, stable side slopes, and floor slopes of less the 4% (Rosgen, 1996). The entire reach consists of moderately flat slopes with channel types of B4 and B4c.
Bank erosion was calculated at 21 different sites within the Wyoma Reach. The BEHI and NBS ratings range between Moderate and Extreme. The measured banks range from 1.5 - 11 ft in height contributing 0.071 tons/year/linear ft. The principal process of stream bank erosion within the Wyoma Reach is fluvial entrainment with some surface erosion. With adequate vegetative cover and sufficient bank armor most of these banks are not a significant source of sediment in the basin. Bank 19 is the ranked the highest in sediment contribution within the reach. This bank at 74 ft long has very little surface protection over stratified layers.

Table 3. Bank erosion by site within the Wyoma Reach of Dunn Creek.

BANK NUMBER	BEHI NUMERIC RATING	BEHI ADJECTIVE RATING	NBS ADJECTIVE RATING	LENGTH (ft)	LOSS cu yds/yr	LOSS tons/yr
5	26	Moderate	Extreme	35	0.89	1.16
6	33.2	High	High	44	1.26	1.64
7	24.7	Moderate	Low	43	0.62	0.81
8	22.2	Moderate	Low	48	0.61	0.79
9	25	Moderate	Low	80	1.36	1.77
10	33.4	High	High	57	1.96	2.55
11	30.6	High	High	37	1.4	1.82
12	44.3	Very High	Moderate	32	1.62	2.11
13	31.3	High	Very high	101	2.55	3.32
14	43.7	Very High	Extreme	44	1.65	2.15
15	39.1	High	Low	100	4.36	5.67
16	40	High	Extreme	152	5.58	7.25
17	37	High	High	75	3.70	4.81
18	43.4	Very High	High	48	3.61	4.69
19	46	Extreme	High	74	12.62	16.41
20	41.9	Very high	Moderate	57	9.06	11.78
21	38	High	High	1	0.1	0.13
22	44.3	Very High	High	83	8.99	11.69
23	39.1	High	High	49	2.08	2.70
24	35.7	High	High	31	1.96	2.55
25	40	High	Moderate	57	2.42	3.15
TOTAL				1,248	68.40	88.95

Map 2. The Wyoma Reach of Dunn Creek.



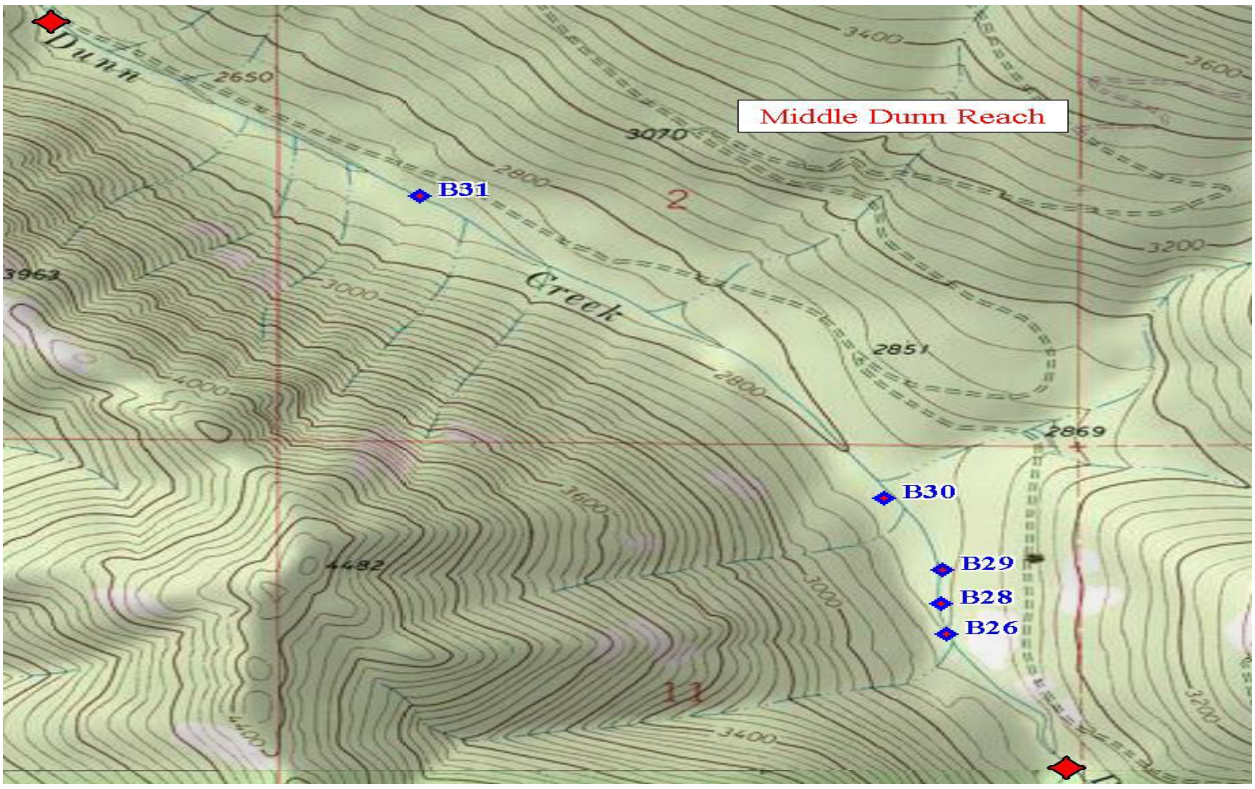
-Middle Dunn Reach-
The Middle Dunn Reach is located upstream of the steep canyon section of Dunn Creek and starts at the natural narrowing of the valley mid-way down the drainage. It is a Valley Type II with moderate relief, stable side slopes, and floor slopes of less the 4% (Rosgen, 1996). The entire reach consists of moderately flat slopes with channel types of B4 and B4c.

Bank erosion was calculated at 6 different sites within the Middle Dunn Reach. The BEHI and NBS ratings range between Moderate and Very High. The measured banks range from 4.5 - 13 ft in height contributing 0.115 tons/year/linear ft. These erosion rates are not much higher than the rates in the Wyoma Reach. The principal process of stream bank erosion within the Middle Dunn Reach is fluvial entrainment with some surface erosion.

Table 4. Bank erosion by site within the Middle Dunn Reach of Dunn Creek.

BANK NUMBER	BEHI NUMERIC RATING	BEHI ADJECTIVE RATING	NBS ADJECTIVE RATING	LENGTH (ft)	LOSS cu yds/yr	LOSS tons/yr
26	39.5	High	Moderate	69	5.39	7.01
27	37.9	High	Very High	28	4.21	5.47
28	38.5	High	Moderate	35	3.30	4.29
29	39.3	High	High	35	2.81	3.65
30	31.3	High	Moderate	38	3.93	5.11
31	43.4	Very High	High	61	4.05	5.27
TOTAL				266	23.69	30.8

Map 3. The Middle Dunn Reach of Dunn Creek.



-Canyon Reach-
The Canyon Reach is located in the lower third of Dunn Creek. It starts at the natural narrowing of the valley at the bottom of the Middle Dunn Reach. It is a Valley Type I with steep landforms, bedrock intrusions, and floor slopes greater than 4% (Rosgen, 1996). The reach consists of steep stream slopes

with channel types of A2, B2a, and B3a. Typical A2/B2 channels are high energy and low sediment supply.

Forest Road 334 encroaches within the floodprone and bankfull areas in several places constricting the channel and destabilizing banks throughout the reach. Bank erosion was calculated at 7 different sites within the Canyon Reach. The BEHI and NBS ratings range between High and Extreme. The measured banks range from 4.5 - 34 ft. in height contributing 0.451 tons/year/linear ft.
Bank 32 has a BEHI rating of Extreme and a NBS of Very High. This bank is estimated to contribute 168 tons of sediment per year and is the single largest sediment source in the drainage. The principal processes of erosion on this bank are surface erosion, soil-fall / rotational mass failure, and fluvial entrainment. Suspected causes are road encroachment into the floodprone area and slope de-stabilization from vegetation removal.

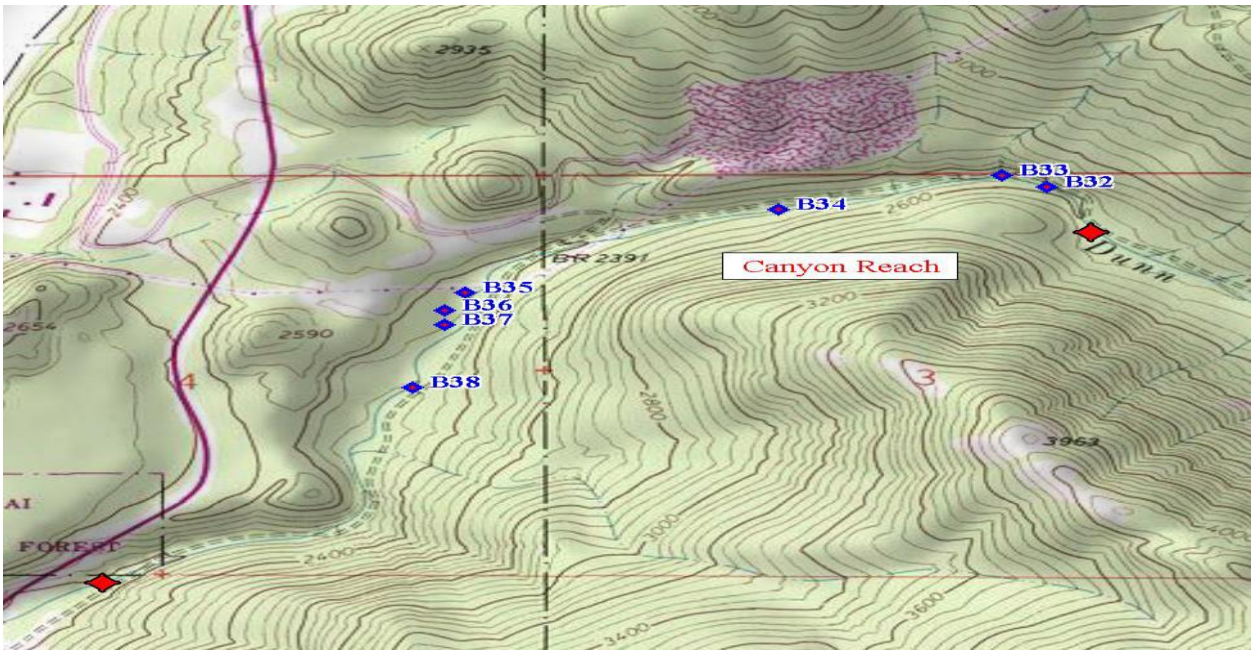
Bank 33 has a BEHI rating of High and a NBS of Very High. It contributes an estimated 25 tons of sediment per year to Dunn Creek. This is the 2nd largest sediment source in Dunn Creek. The principal processes of erosion on this bank are surface erosion, soil-fall / rotational mass failure, and fluvial entrainment. Suspected causes are road encroachment into the floodprone area and slope de-stabilization from vegetation removal.

The total sediment contributions of Banks 32 and 33 (193 tons) are more than all other measured banks combined (169 tons).

Table 5. Bank erosion by site within the Canyon Reach of Dunn Creek.

BANK NUMBER	BEHI NUMERIC RATING	BEHI ADJECTIVE RATING	NBS ADJECTIVE RATING	LENGTH (ft)	LOSS cu yds/yr	LOSS tons/yr
32	52.8	Extreme	Very High	216	129.72	168.64
33	38.9	High	Very High	101	19.71	25.62
34	35	High	Moderate	25	5.17	6.72
35	0	Very Low	High	35	0.60	0.78
36	40.9	Very High	High	17	1.33	1.73
37	42.8	Very High	High	33	3.77	4.90
38	45.4	Very High	High	45	3.58	4.65
TOTAL				472	163.88	213.04

4. The Canyon Reach of Dunn Creek.



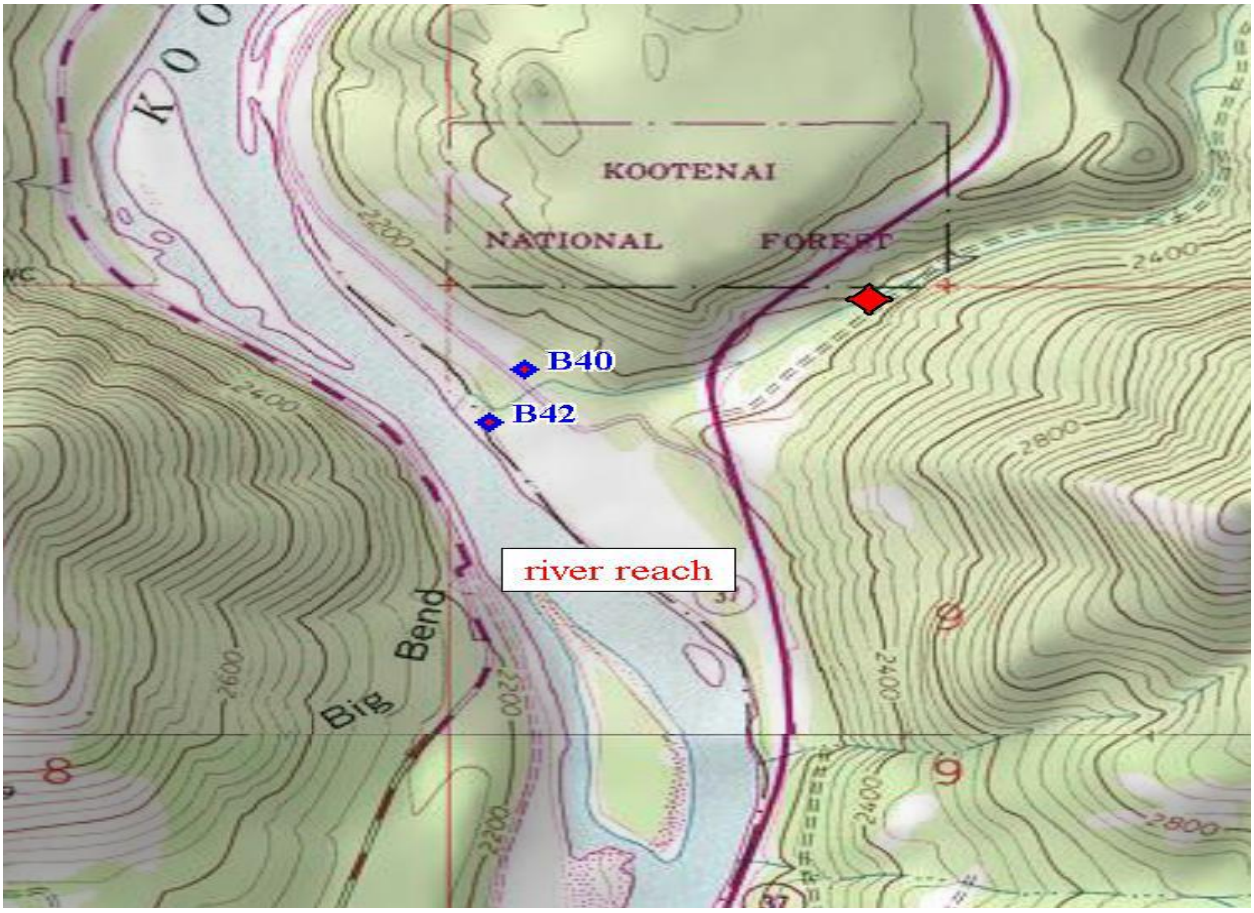
-River Reach-
The River Reach starts at the natural widening of the valley below the Canyon Reach. It is a Valley Type III that is primarily a deposition reach (Rosgen, 1996). It is an alluvial-fan landform with moderate relief and slopes of 2%. The reach consists of stable channel types of B4 and B4c and unstable D4 and F4 types.

Bank erosion was calculated at 4 different sites within the River Reach. The BEHI and NBS ratings range between Moderate and Extreme. The measured banks range from 4 - 7 ft in height contributing 0.097 tons/year/linear ft. These erosion rates are similar to the rates in the Wyoma Reach and slightly lower than the Middle Dunn Reach. The principal process of stream bank erosion within the River Reach is fluvial entrainment with some surface erosion

Table 6. Bank erosion by site within the River Reach of Dunn Creek.

BANK NUMBER	BEHI NUMERIC RATING	BEHI ADJECTIVE RATING	NBS ADJECTIVE RATING	LENGTH (ft)	LOSS cu yds/yr	LOSS tons/yr
39	32.5	High	High	56	3.54	4.60
40	47.7	Extreme	High	48	5.85	7.61
41	38	High	Moderate	39	2.69	3.50
42	45.7	Very High	High	75	4.33	5.63
TOTAL				218	16.41	21.34

Map 5. The River Reach of Dunn Creek.



Summary
The findings presented in this report are designed to display the existing condition in terms of bank

instability and subsequent sedimentation. This report will hopefully aid in supplementing future restoration planning and design, whether that be strictly riparian revegetation, total channel reconstruction or a combination of both. The data can be used to prioritize where to begin restoration and to shed light on specific contributions and the downstream impacts. The current instabilities of Banks 32 & 33 and their immediate effects downstream may warrant a "top-down" approach to future restoration.

References:

Rosgen, D.L. and H.L. Silvey. 1996. Applied River Morphology. Printed Media Companies, Minneapolis, MN. 365 pp.

Rosgen, D.L. 2008. River Stability Field Guide. Color House Graphics, Grand Rapids, MI. 270 pp.

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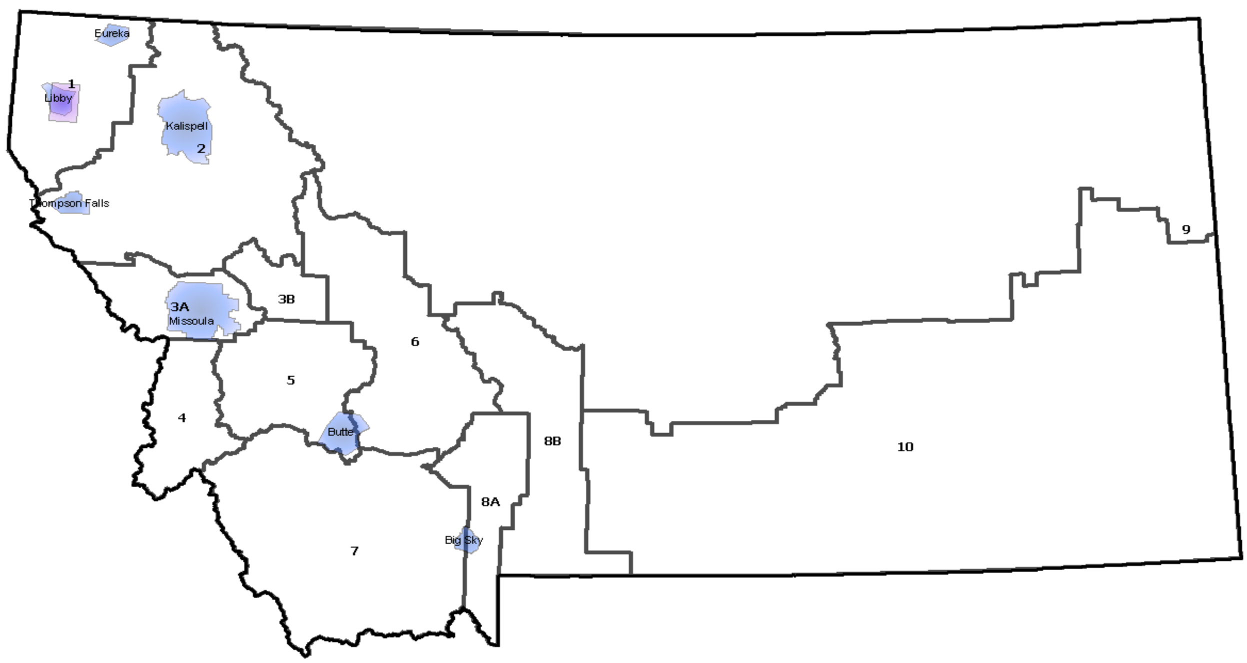
APPENDIX K: MONTANA AIRSHEDS and IMPACT ZONES



MONTANA AIRSHED 1 and 2 BOUNDARY DESCRIPTIONS

1) **Airshed 1** contains all of Lincoln County and the NW tip of Sanders County. The area of Sanders County included is bordered on the north and east by Lincoln County, on the west by the Idaho border, on the south by the southern edge of the Beaver Creek drainage, through Noxon Reservoir, and the southern edge of the Vermillion River drainage.

a. The ***Libby Impact Zone,*** within Airshed 1, includes all land within the following described areas: Beginning at Kootenai Falls (1), going SE to Scenery Mountain (2), then south to Indian Head (3), then south to Treasure Mountain (4), then south to Mount Snowy (5), then east to Double N Lake (6), then across Highway 2 going NE to McMillan Mountain (7), then north to Swede Mountain (8), then NE across Highway 37 to the Vermiculite Mine (9), then west to Sheldon Mountain (10), then WNW to Flagstaff Mountain (11), then SW to Kootenai Falls (1), the point of the beginning.
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2) Airshed 2 contains all of Flathead and Lake Counties and all of Sanders County except for the NW tip (described in paragraph 1), which is part of Airshed 1. Airshed 2 also contains the northern portions of Missoula and Powell Counties, which lies in the Swan River drainage, and the South Fork of the Flathead River drainage. The boundary here is the divide between the Swan River and the Clearwater River drainages in Missoula County and the divide between Monture Creek and the South Fork of the Flathead River drainage in Powell County. Also, the northern half of Mineral County (that portion north of Superior) is included in Airshed 2. This line runs east and west between T16N and T17N, M.P.M., then north along Mineral County to Sanders County line.

a. The ***Kalispell Impact Zone***, within Airshed 2, includes all land within the following described area: Beginning in the town of Hungry Horse, cross the Flathead River and head NW to Teakettle Mountain, then WSW to a point on Trumbull Creek between sections 24, 25 in T31N, R21W. Go directly West to the corner of sections 20, 21, 28, and 29 in the same Township and Range, then head North to the corner of sections 16, 17, 20, and 21, same T and R. Now head West to the line that divides R21W and R22 W, then North to Big Mountain, then SW down Big Mountain Ridge face toward Whitefish Lake at a point just SE of where Hell Roaring Creek enters the lake. Cross the lake to a point called "Vista" in section 9, T31N, R22W, and then generally follow the higher points, through Woods Lake, Murray Lake, crossing Highway 93 in section 24, T31N, R23W. Continue through Little Bootjack Lake and follow the high points generally WSW to a point on Tally Lake where Logan Creek enters the lake. The boundary crosses the lake generally SSW to Talley Mountain, then generally South to Reid Point Lookout, then South along the 39

"Reid Divide" to the boundary between T30N, T29W, and R23W, and R24W. Turn SE and follow the ridge to a point on Big Lost Creek in section 16, T29N, R23W, then follow the ridge around to "McMannamy Draw" in section 26, T29N, R23W, then generally following the ridges South to Boorman Peak and then South along the Pack Trail to a point where "Dower Draw" enters Ashley Creek. Cross Ashley Creek to a point at the foot of the ridge in section 19, T27N, R22W, then follow this ridge up to Wild Bill Mountain, then straight to Eagle Mountain, then straight to Blacktail Mountain, then generally NW to Lion Mountain, then head straight SE through Baldy Mountain, and on to the Flathead/Lake County line on Highway 93 in section 33, T26N, R20W. Boundary now head directly East across Flathead Lake to Highway 35 and then follows the shore line North along the Flathead/Lake County line to the corner of sections 4,5,8 and 9 in T26N, R19W, then directly North to Hash Mountain, then straight to Doris Mountain then straight to Columbia Mountain and finally straight back to the start point in the town of Hungry Horse, the point of the beginning.